



**COMPARISON OF PROFIT MARGIN PERCENTAGES BETWEEN PRIME  
CONTRACTORS AND SUBCONTRACTORS FOR AIRCRAFT, MISSILES, AND  
UNMANNED AERIAL VEHICLES**

THESIS

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AFIT-ENV-MS-17-M-215

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### **Abstract**

In order to achieve its mission of providing the military forces needed to deter war and to protect the security of our country the Department of Defense (DoD) routinely acquires new weapons systems. The DoD acquires these systems by contracting the design, development, and manufacture to defense contractors. Many of today's systems are highly complex systems of systems comprised of many specialized components. For systems such as these, the primary defense contractor tends to subcontract out parts of the effort to other defense contractors for these specialized subcomponents. The DoD collects detailed information on the cost of weapon systems to include profit for the primary contractor and all subcontractors whose share of the effort is over the specified dollar threshold. The purpose of this study was to determine if there is a profit advantage in either having a prime contractor or subcontractor role within DoD systems acquisition. There is the perception by some parties that subcontractors are in a better position to earn a higher profit percentage compared to prime contractors. The researchers used contractor cost data for programs from the aircraft, missiles, and UAV commodities to see if one contractor group has an advantage over the other group. The researchers analyzed this data by phase (development and production), contract type (cost reimbursable, fixed, and a mixture of the two), commodity, and service (Air Force, Army, and Navy). The researchers found neither contractor group to have a consistent advantage over the other.

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Aaron M. Rhea

## Table of Contents

	Page
Abstract .....	iv
Table of Contents .....	vi
List of Figures .....	viii
List of Tables .....	x
I. Introduction .....	1
General Issue .....	1
Problem Statement/Research Question .....	4
Methodology/Assumptions.....	5
Summary.....	7
II. Literature Review .....	9
Chapter Overview.....	9
Excessive Profits .....	9
Performance.....	11
Contracts and Cash Flows .....	12
Innovation.....	14
The Relationship.....	16
Defense Market Landscape and Competition.....	17
Contractor’s View on DoD Profit Policy .....	20
Current Profit Percentage .....	21
Excessive Pass-Through Charges.....	22
Chapter Summary .....	23
III. Methodology .....	24
Introduction .....	24

Database .....	24
Population.....	25
Calculations/Business Case Analysis .....	33
Summary.....	37
IV. Analysis and Results.....	38
Chapter Overview.....	38
Prime/Subcontractor CDSRs .....	38
Development and Production .....	43
Contract Type .....	49
Commodity .....	57
Service .....	64
Summary.....	71
V. Conclusions and Recommendations .....	72
Chapter Overview.....	72
Conclusions of Research .....	72
Differences with <i>Analysis of Subcontractor Margins</i> .....	74
Significance of Research .....	74
Limitations.....	75
Recommendations for Future Research.....	76
Summary.....	78
Appendix.....	79
Bibliography .....	80
Vita .....	83



## List of Figures

	Page
Figure 1: DCARC Query .....	26
Figure 2: <i>Analysis of Subcontractor Margins</i> (Figure 3-11) .....	31
Figure 3: <i>Analysis of Subcontractor Margins</i> (Figure 3-14) .....	32
Figure 4: Prime versus Sub (Bar Chart).....	39
Figure 5: Prime versus Sub (Scatter Plot).....	40
Figure 6: Prime versus Sub (Box Plot) .....	41
Figure 7: Development & Production (Bar Chart) .....	44
Figure 8: Development CDSRs (Scatter Plot) .....	45
Figure 9: Development CDSRs (Box Plot).....	46
Figure 10: Production CDSRs (Scatter Plot) .....	47
Figure 11: Production CDSRs (Box Plot).....	48
Figure 12: Contract Type (Bar Chart).....	49
Figure 13: Cost Reimbursable CDSRs (Scatter Plot) .....	51
Figure 14: Cost Reimbursable CDSRs (Box Plot).....	52
Figure 15: Fixed Contract CDSRs (Scatter Plot).....	53
Figure 16: Fixed Contract CDSRs (Box Plot) .....	54
Figure 17: Other Contract CDSRs (Scatter Plot).....	55
Figure 18: Other Contract CDSRs (Box Plot) .....	56
Figure 19: Commodity (Bar Chart).....	57
Figure 20: Aircraft CDSRs (Scatter Plot) .....	58
Figure 21: Aircraft CDSRs (Box Plot).....	59

Figure 22: Missile CDSRs (Scatter Plot) .....	60
Figure 23: Missile CDSRs (Box Plot) .....	61
Figure 24: UAV CDSRs (Scatter Plot) .....	62
Figure 25: UAV CDSRs (Box Plot).....	63
Figure 26: Service (Bar Chart).....	64
Figure 27: Air Force CDSRs (Scatter Plot) .....	65
Figure 28: Air Force CDSRs (Box Plot).....	66
Figure 29: Army CDSRs (Scatter Plot) .....	67
Figure 30: Army CDSRs (Box Plot).....	68
Figure 31: Navy CDSRs (Scatter Plot) .....	69
Figure 32: Navy CDSRs (Box Plot).....	70

## List of Tables

Table 1: Contract List .....	29
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## **I. Introduction**

### **General Issue**

A widely discussed topic among Government and public entities is the profit received by defense contractors. The debate often focuses on whether defense contractors make excessive profit. Some evidence tends to support that contractors do receive excessive profit (Wang & San Miguel, 2012). This is an important discussion because the Department of Defense (DoD) and the taxpayer want to make sure they are not overpaying for military assets; however, they also want to make sure contractors provide the best products and services contractors can produce, and are compensated properly for their effort and risk. Implementing policies to limit contractor profit may result in companies being less inclined to deal with the DoD or may make it difficult for them to recruit the best talent. A factor to recognize is that the DoD procures goods that are technologically advanced and, therefore, some parties make the argument that DoD contractors should receive higher profit margins than companies in the commercial sector should.

The defense industry is not like a commodity business that operates on razor-thin per unit margins that later makes large profit due to the high quantity of goods they are able to sell. A defense company producing weapons may only be able to sell a limited number of end items, which may require them to earn a high profit margin to survive. Defense contractors usually obtain very large contracts from the DoD worth hundreds of millions to billions of dollars. Examples include Boeing receiving a \$3.2 billion contract for Joint Direct Attack Munition (JDAM) tail kits and United Launch Services receiving

a \$138 million contract for launch vehicle work with the Air Force (“U.S. DEPARTMENT OF DEFENSE: Contracts,” 2016). In addition, in the defense industry whoever produces the first lot of an end item has a good chance of producing all the remaining lots for that weapon. “Procurement contracts usually are awarded annually on a sole-source basis” (Dominy et al., 2011, p. 9). Companies in the commercial sector often do not enjoy this type of security in which there is usually a buyer only once development is completed. On the other hand, the commercial sector does not have to deal with excessive bureaucracy and its added costs like in the defense industry. Firms in the defense industry must abide by the Federal Acquisition Regulations (FAR) and Defense Federal Acquisition Regulation Supplement (DFARS). Commercial companies usually do not have to rely on one customer to buy their products unlike defense firms, who in most cases have no one else to sell their products to other than a few specific departments within the government.

To deal with these unique issues, one method that government contracting officers use to determine profit for negotiations is the weighted guidelines method (WGL) (“Subpart 15.4—Contract Pricing,” n.d.), which is unpopular with defense contractors (Davis, 1995). Evidence supporting that the WGL is unpopular among defense contractors is that they do not use the WGL when negotiating profit with their subcontractors (Davis, 1995). In addition, there is the issue of the government using certain contract types to limit profit potential for defense contractors. Some of the various contract types employed by the DoD are: cost-plus-fixed-fee (CPFF), cost-plus-award-fee (CPAF), firm-fixed-price (FFP), and fixed-price-incentive-fee (FPIF) (“Subpart 15.4—Contract Pricing,” n.d.). Usually in the research and development

phase, the government likes to employ CPAF and CPFF contracts. Between these two contracts, “contractors have indicated a preference for CPAF over CPFF contracts because of the higher profit potential” (Arnold, McNicol, & Fasana, 2009, p. 15). The reason contractors prefer CPAF over CPFF is due to CPFF contracts limiting the contractor to 15 percent of the contracted cost (Subpart 15.4—Contract Pricing, n.d.). Whereas for a CPAF contract, “limits are not defined by the guidelines in DFARS 215.404 and can enable the contractor to make higher gains on development contracts” (Arnold, Harmon, et al., 2009, p. 17). *Ceteris paribus*, a company would like to have a contract that will allow them to earn a higher profit margin.

One-way to determine whether defense profits are excessive or not, is to compare them to the commercial sector. “Earnings of defense companies are typically a lower fraction of total sales than those of firms in other industries” (Arnold, Harmon, et al., 2009, p. S-4). However, defense contractors can earn lower margins because they have the advantage of receiving progress payments from the government in which they can receive up to 90 percent of costs for work completed (Arnold, Harmon, et al., 2009). These progress payments suggest that “low margins early in the life of a program can have as much or more value than higher margins later” (Arnold, Harmon, et al., 2009, p. 39). Companies in the commercial sector are not guaranteed progress payments and may have to wait years to receive payments for their products. For example, “an automotive company may not receive a single payment from a customer for many years after the product is first conceived” (Arnold, Harmon, et al., 2009, p. 39). Due to these progress payments, companies in the defense industry may be less likely to be constrained on funds relative to companies outside the defense sector. Based on progress payments,

defense firms most likely do not need to take out loans for development or production efforts, or if they do, it is most likely for a much shorter time than companies would need to in the commercial sector. As there are differences to the profit between companies in the commercial sector versus the defense industry, there may also be differences between companies in the defense industry. The focus of this study is to show if there are any systemic advantages in terms of profit percentage by being a company in the defense industry that does not deal directly with the DoD (i.e. subcontractors).

### **Problem Statement/Research Question**

There are many published articles discussing whether defense prime contractors (contractors who work directly with the government) receive enough profit or receive too much profit, but few appear to discuss the profit percentage received by subcontractors (the contractors to the defense primes). This is an interesting topic because primes may be restricted to the amount of profit they can receive, whereas there may be no such restrictions placed on subcontractors. This leads to an examination of the following questions:

1. Which party within the defense industry, on average, ends up with a higher realized profit/fee percentage – primes or subcontractors?
2. Does the type of contract (i.e. cost reimbursable or fixed), result in one group with a higher profit/fee percentage?
3. Does one group receive a higher profit/fee percentage for each of the following commodities: aircraft, missiles, and UAVs?

4. Does one contractor group have an advantage over the other in regards to Service (Air Force, Army, and Navy)?

This is important because if subcontractors earn a higher profit percentage than primes, primes may begin to favor competing for more subcontracts since it will result in them receiving less scrutiny about a potentially higher profit percentage. If more primes compete for subcontracts, this may push competitors out of first-tier subcontracts because the prime may have an advantage over other companies due to the likelihood of having more resources.

Another issue to consider is why one group, on average, earns a higher profit percentage than the other. Due to the consolidation of the defense industry over recent years, there are only a handful of primes able to compete to be the lead for new acquisition programs (Watts, 2008). There is reason to believe that prime contractors would receive a higher-realized profit percentage due to only a handful of companies able to manage the regulations placed on primes by the Government. Indeed, the regulations placed on prime contractors may entice more competitors into the subcontracting field due to increased oversight. However, this larger field of competitors in the subcontractor arena could lower profit percentages through increased competition.

### **Methodology/Assumptions**

Primes and subcontractors are required to provide a Contractor Cost Data Report (CCDR) when a contract is worth more than \$50 million or, “if determined to be a high-risk or high-technical-interest contract priced between \$20 million and \$50 million by the Program Manager and/or the DDCA,” (Deputy Director, Cost Assessment) (*Department*



*of Defense Instruction 5000.02*, 2015, p. 70). This research will only concern itself with financial data reports for primes and subcontractors uploaded into The Defense Automated Cost Information Management System (DACIMS), which is part of the Defense Cost and Resource Center (DCARC). The researchers used this financial data to calculate realized profit percentages for primes and subcontractors.

There are various ways to determine profit margin. Businesses tend to look at profit margin as a percentage of profit to sales, whereas-the DoD determines profit percentage by dividing profit over cost (Arnold, Harmon, et al., 2009). The General and Administrative expense is now considered part of contractor costs, which was not the case before April 2002 (Arnold, Harmon, et al., 2009).

There are multiple factors that can possibly affect profitability of firms in the defense industry. Such factors include the Weapons Systems Acquisition Reform Act of 2009 (WSARA); economic conditions such as the Great Recession; and the changing landscape of the defense industry through mergers and firms leaving the defense industry. Other factors include sequestration, wartime funding (OCO funding), and national political leadership. This study will not test these factors to determine if they play a role in affecting contractor profit, but does make note that these events have possibly had an impact on contractor profit.

The goal for the implementation of WSARA is to improve the acquisition process by making sure the DoD procures affordable weapons. This acquisition reform places an emphasis on reducing cost overruns and managing tradeoffs between cost, schedule, and performance. WSARA recommends awarding contracts through competition and dual-sourcing procurement when possible (United States General Accounting Office, 2012).

Another event to possibly impact contractor profit is the Great Recession, which was a downturn in both the US and global economy that occurred between 2007 and 2009. During this period, there was a major uptick in unemployment due to a loss of employment in the following sectors: construction, manufacturing, retail trade, financial activities, and professional and business services (“The Recession of 2007–2009: BLS Spotlight on Statistics,” n.d.). It is conceivable to think that the Great Recession may have caused a reduction in profits for contractors.

Another factor that has potentially shaped contractor profit is the consolidation of the defense industry. The period of 1948-1960 was a time of growth for defense firms due to the build-up of the military. “From 1952 to 1960, defense spending was between 9.3 and 13.2 percent of the US GDP” (Watts, 2008, p. 15). Following this period, from 1960 until 1990, defense firms began leaving the defense industry for the commercial sector due to changing market conditions such as an increase in commercial goods. By the time the Cold War ended, the US was in the process of reducing military expenditures and a reduction of new acquisition programs in the 1990s. An outcome of the decrease in military expenditures and programs resulted in fewer defense firms (Watts, 2008).

## **Summary**

This chapter presented the idea of comparing realized profit between primes and subcontractors and determining reasons as to why this difference may exist. The next chapter is the Literature Review, which discusses the defense industry and what factors play a role in affecting contractor profit. It looks at regulations governing profit for primes, and how these regulations have changed over time-along with views from primes

about the profit level they receive. Chapter III addresses the methodology for determining realized profit percentages for both prime contractors and subcontractors. Chapter IV presents and analyzes the results based upon the work in Chapter III, and demonstrates whether one group receives a higher profit percentage than the other. The final chapter is the conclusion and presents ideas for future research, such as how profit percentages may change over the course of a program and how profit percentages from defense contracts compare to a company's overall profit margin.

## **II. Literature Review**

### **Chapter Overview**

This chapter presents different topics that shape the discussion of contractor profit. One area addresses the argument of whether defense contractors earn too much profit. Another aspect of the discussion ties contractor profit to performance and the cash flows contractors receive over the course of a contract. Next, the researchers explore the relationship between the government and contractors to see if it may affect contractor profit. Later, the researchers look at the landscape of the defense market to see whether it may play a role in influencing contractor profit/fee. This chapter then examines contractors' opinions of DoD profit policy along with the profit percentages contractors have received in recent years. The last portion of this chapter discusses excessive pass-through charges.

### **Excessive Profits**

The US Government has limited resources to use to procure weapons systems, but there are numerous capabilities that the DoD must procure with those limited resources. Inherently, profit is sometimes seen as a cost without value. Frank Kendall, former Under Secretary of Defense for Acquisition, Technology, and Logistics, believes that profit is not the enemy but a way to reward contractors and motivate them to cut costs. He has worked in the private sector and knows that profit is essential to a business's success and livelihood (Kendall, 2015). Kendall has stated, "BBP [Better Buying Power] is not a 'war on profit' – we are not trying to reduce profit as a way to reduce costs" (Kendall, 2015, p. 3). "Better Buying Power (BBP)' is the implementation of best

practices to strengthen the DoD's buying power and to improve industry productivity" (Better Buying Power, n.d.). Although contractors need profit, there is still an issue over the amount they receive.

The idea of excessive profits is a much-discussed issue. "An ongoing and seemingly never-ending debate in policymaking circles in Washington concerns whether defense profits are too high or too low and whether price levels allowed under profit policy should be adjusted to correct this problem" (Rogerson, 1989, p. 13). A 2012 report conducted by Wang and San Miguel (2012) shows support that, "defense contractors earn excessive profits relative to their industry peers." They noted the following:

Excessive profit was more pronounced after 1992, consistent with the conjecture that the significant defense industry consolidation after 1992 enabled superiority due primarily to both the strong bargaining power and increased political influence of the remaining firms. (Wang & San Miguel, 2012, p. 23)

Excessive profit goes beyond the U.S. defense industry though. A study conducted by Tom Neels (2014) found that defense contractors both in the US and internationally, receive profits considered excessive. He notes that the German defense industry is an example of high profit margins outside the US defense industry. German contractors require high profits due to having restrictions on what they can sell outside of Germany. This can limit the quantity or products they sell by not having access to foreign governments, which forces them to markup the costs of weapons they sell to the German government due to the lost potential for greater revenue. A unique aspect of the German defense industry is that the, "German government always bears the risk of rising costs. This leads to the implication that profits from contracts with the German government are

pure savings for contractors” (Neels, 2014, p. 18). The next topic looks at tying profits to performance.

## **Performance**

Kendall believes in rewarding contractor performance and that incentives play a role in reducing costs. He makes the point that the defense industry is a great sector for companies to conduct business because it is a stable market. It is reassuring for businesses to know that they have a customer out there who consistently needs to be supplied with goods. In addition, he mentions that the Government pays for the majority or even all of development work and, therefore, defense contractors usually do not have to worry about the costs associated with it. For the most part, defense contractors do not have to worry about spending funds on a product that does not work and is unable to recoup the costs for it. Progress payments are another great aspect of working in the defense industry according to Kendall, because it allows companies to have a consistent stream of money. This puts defense companies at a favorable advantage compared to companies in the commercial sector. According to Kendall, incentives are necessary to push the contractors above [meeting] the minimum [contractual requirements] (Kendall, 2015).

Kendall (2015) notes that contracts need to be arranged in a way to favor rewarding contractors with profit/fee when they find ways to reduce costs which benefits the Government, but penalize contractors by reducing profit when they cause overruns for a program. He is a proponent of having contractors receive a portion of the savings from program underruns, but being liable for additional costs the program may incur

when there is an overrun. By reducing costs one year, the Government will achieve cost savings for future years (Kendall, 2015). The next topic discusses some of the contract types utilized by the Government with contractors and cash flows contractors receive from the Government.

## **Contracts and Cash Flows**

The DoD uses various types of contracts to reduce cost growth and incentivize defense contractors. Typically, during development, the Government likes to use cost-reimbursement contracts due to the nature of the risk of the work. The contractor works on a new design during development, which brings with it a certain level of uncertainty and risk. This risk and uncertainty may lead to an overrun causing an increase in costs (Arnold, Harmon, et al., 2009). Overruns may result from overly optimistic estimates or schedules that do not match up with resources on hand. Another cause of overruns can be underestimating what it will take to meet user requirements (GAO, 2011). The Government uses cost-reimbursement contracts so that additional costs that may have been difficult to anticipate at the beginning of the contract do not burden the contractor. The cost risk for cost-reimbursable efforts is ultimately on the Government. On the other hand, firm-fixed price contracts are used instead of cost-plus-fixed-fee contracts during production because the work is more stable and there is less incentive with a cost type contract to minimize costs (Arnold, Harmon, et al., 2009). Of the contracts used by the government in development, “the CPAF contract...is preferred by contractors because its limits are not defined by the guidelines in DFARS 215.404 and can enable the contractor to make higher gains on development” (Arnold, Harmon et al., 2009, p. 17). The CPAF

is necessary according to contractors because, “they must be able to make high profits on development in isolation from production to remain competitive with other high-technology industries” (Arnold, Harmon et al. 2009, p. 17). According to the data, defense contractors on average make about 2.9 percent more on FFP contracts than CPFF contracts (10.5 versus 7.9 percent, respectively) (Arnold, Harmon et al., 2009). “Actual profit rates were estimated from completed contracts as reported in Contractor Cost Data Reports (CCDRs)” (Arnold, Harmon, et al., 2009, p. 21). In addition to the types of contracts used by the DoD to incentivize contractors and to reduce their risk, contractors are eligible to receive payments at certain points before the completion of a contract.

DoD contractors are eligible to receive performance or progress payments over the course of a contract, which can be very beneficial for contractors compared to the commercial sector. “With performance-based payments, the contractor receives a pre-agreed payment for completing a pre-agreed milestone” (Arnold, Harmon et al., 2009, p. 9). Performance based payments are the preferred method because the contractor knows what they must accomplish to get a payment and the government does not have to spend time figuring out how much progress has been completed. “Performance payments cover up to 90 percent of the pre-agreed price at the milestone instead of up to 80 percent of cost with progress payments” (Arnold, Harmon, et al., 2009, p. 9). As discussed earlier, performance payments may allow a defense contractor to maintain an advantage over a company in the commercial market that may have a higher profit margin (Arnold, Harmon et al., 2009). The next topic looks at the relationship between profit potential and how it can influence innovation.



## **Innovation**

Defense industry regulations can limit how much profit a defense firm can earn. The Federal Acquisition Regulation (FAR) Subpart 15.4 and Defense Federal Acquisition Regulation Supplement (DFARS) Subpart 215.4 govern defense profits. Regulated industries are typically setup to reduce or eliminate profits received by suppliers. The defense sector is not the typical regulated industry, since there are only about five primes that develop and produce products that are not simple but are very innovative and time consuming to make. This provides negotiating power for primes since the DoD must rely on them when they require additional units of an end-item or a new weapon system quickly (Rogerson, 1989). “In the long run profit policy has no effect at all on profits, rather it controls the level of rent-seeking expenditures. If entry and exit are possible then overall economic profit must be zero” (Rogerson, 1989, p. 11). Entry into the defense market can be difficult since there are only five major US defense firms able to be the prime contractor for the majority of major acquisition programs. These five companies are Boeing, Raytheon, Northrop Grumman, Lockheed Martin, and General Dynamics. Depending on the commodity, only two or three of these major prime contractors are able to compete for a contract (Watts, 2008). “From the mid-1980s through 2007, a number of major American companies have chosen to leave the defense industry but no major non-defense firms have chosen to enter it” (Watts, 2008, p. 42). Innovation can be an important factor for determining the contractor for a contract award.

Usually, firms end up competing during the development phase to secure the rights to produce a weapon for the DoD. By enabling one firm to produce the weapon and receive a majority of their profits during production, it leads to fiercer competition

during development and thus benefits the DoD due to increased innovation. Rogerson (1989) argues that defense firms should be rewarded higher margins for innovative ideas during production; otherwise, there is no incentive for them to innovate. In addition, Rogerson (1989) notes that the government should not reduce profits for contractors during production and add them to the development phase to increase innovation. This would be too burdensome and costly to determine the measures that signify innovation, and to write them into a contract according to Rogerson (1989). He gives an example of the development of the F-16 and incentives created by the profits associated with production. Northrop Grumman and General Dynamics competed to win production of the F-16, and their competition led them to spend their own money in addition to what the government gave them to produce the best product to win the contract. If the profit incentive during production did not exist, these two firms most likely would not have spent their own money during development (Rogerson, 1989).

Rogerson later discusses dual-sourcing of production, which the government uses to try to reduce production costs. Dual-source contracts are a contracting method in which the government awards a production contract to two firms to produce the same product. This leads to reduced learning-curve benefits, since each firm is producing less than they normally would have as the sole-source maker; however, it does cause firms to reduce costs since competition is involved. The major problem with dual-sourcing though is it that it reduces profit because of the competition. A firm is likely to put forth less money and effort into something when it knows its reward, in this case, profit is reduced (Rogerson, 1989). To further gain insight into profit, one needs to look at the relationship between the government and contractor.

## **The Relationship**

The defense industry is a complex environment that requires a collaborative relationship between the DoD and defense contractors to produce leading edge weapons needed by the DoD (Patterson, 1976). “The relationship that develops during the life of a program can have a pronounced effect on costs, schedules, and ultimately, the success of a program” (Patterson, 1976, p. 1). Though there should be a healthy relationship between defense contractors and the government, it hardly seems the case. The Government feels they do not need to worry about their relationship with contractors due to the fact, that they are the only buyer of defense products and, therefore, contractors have no other options if they do not like the terms set forth by the Government. In addition, the DoD feels it may be better to have an adversarial relationship with defense contractors, since this may benefit the Government during contract negotiations (Patterson, 1976).

Another example of why there may be an adversarial relationship could be due to the case of Government contracting officers fighting to get the lowest possible price for contracts. Since, Government-contracting officials may strive to lower contractors’ profit, this leads to defense contractors doing whatever is necessary to ensure they receive what they believe they deserve for working with the Government. Actions by defense contractors also result in this adversarial relationship, in addition to actions by the Government (Patterson, 1976).

Conversely, defense contractors have employed some creative tactics that have agitated the DoD. In one example, a defense contractor quoted a price to Congress for a

modification for an aircraft program to help their company gain approval from Congress, which led to the Air Force negotiating a contract with this defense firm.

When a formal offer was made, the price had risen sharply. The Air Force had no choice but to request additional money. In the eyes of Congress, who recalled the company's marketing effort, it appeared that the first thing the Air Force had done was to overrun the program. (Patterson, 1976, pp. 11–12)

Another instance, which has caused the DoD to view defense contractors unfavorably, is due to contractors underbidding on contracts. Contractors may do this so that they can win the initial production contract so as not to lose future production lots for a weapons system. Underbidding can create an adversarial relationship, because it may lead to increased costs on future production lots for a weapons system (Patterson, 1976).

Another area that factors into contractor profit is the competitive landscape of the DoD.

### **Defense Market Landscape and Competition**

Although competition for defense acquisition contracts is a legal requirement, today's defense landscape presents challenges. In the commercial market, there is typically someone or some entity to buy a product a business is selling. This is not the case in the defense industry. If the Government does not wish to buy the product, the defense contractor usually does not have another buyer. Due to this, the Government usually provides most or even all of the development costs for weapons systems (Dominy et al., 2011). This is different for businesses outside the defense industry in which, "in a commercial market, the seller is not only responsible for deciding what to produce, but also for funding the development and production of the product" (Dominy et al., 2011, p. 2). A negative for defense firms though is they must deal with the regulations that occur from working within the defense sector. The reason the DoD strives for competition is

that it can drive prices down. Achieving competition in today's market tends to be tougher than in the past. "At one point in the 1950s, for example, the United States Air Force alone was funding eight jet fighter research and development (R&D) programs and seven bomber R&D programs" (Dominy et al., 2011, pp. 4–5). The ability for a larger number of firms to exist was more feasible in prior decades because of the large number of contracts to go around. Northrop was able to win the contract for the F/A-18 with McDonnell Douglas after losing to General Dynamics for the F-16, but Boeing had no one to offer its design after losing award of production and development to Lockheed Martin for the F-35. In addition, decreased unit production has made it more difficult for the DoD to allow for more competition. An example of decreased production is the Army having to significantly cut back tank production from a few hundred every year a few decades ago to a tenth of that in the late 90s (Dominy et al., 2011). To deal with limited players in the defense sector, the DoD has employed various methods to ensure some level of competition.

One method of competition typically used by the DoD is the weapon systems franchise in which the DoD awards production contracts on an annual basis to the contractor who develops the weapon system. This is the preferred method, because it can incentivize defense contractors to spend their own money and ensure they win the development competition--leading to increased innovation. In the case of the F-22, the firms involved in development each spent a significant amount of their own money for the proposals to increase their odds of winning. If firms are discouraged from using their own funds during development, they will utilize their best personnel to win the contract (Dominy et al., 2011). Another form of competition involves dual-sourcing.

Dual-sourcing occurs when the DoD awards production contracts to two firms with the firm having lower costs receiving a higher portion of the production quantity. This form of competition is typically utilized by the Navy to ensure a weapon system can continue to be produced in case something happens to a supplier. There are many benefits to this form of competition. It can promote lower costs, allow for increased production when needed, improve quality, and incentivize a higher inclination to fix problems by the contractor due to the competition. For this type of situation to work, the Government must be the one to invest in development because the use of multiple contractors will most likely reduce potential contractor profit. A problem with this form of competition is it reduces cost savings from the learning curve due to the fact that each contractor is building less quantities separately than if there were only one contractor (Dominy et al., 2011). A third form of competition deals with near-substitutable systems.

Near-substitutable systems can occur when another end item can be competed somewhat easily as a second option, i.e., something that has already been developed. “The definition of near-substitutable systems is the following: systems that have overlapping capabilities, but are substantially different in some dimensions” (Dominy et al., 2011, p. 31). In one situation, the government asked Boeing for a proposal involving the 747-400F to compete against the C-17 due to cost overruns and schedule delays. This was used as a way to put pressure on the contractor to get the C-17 back on track. Competition of near-substitutable systems is used more for quality-type issues (Dominy et al., 2011). These forms of competition employed by the government can only be used at the prime level, since control of subcontractors is usually left to the prime.

The prime contractor makes the decision of whether to build or subcontract out the weapon system. This can erode the benefits of competition, as only a few companies may be able to compete at the sub-level for a product, or the prime chooses not to subcontract work. If there is not much competition at the sub-level, this can give the sub the upper hand in negotiations with primes and force the prime to give the sub a higher profit percentage. In contrast, the prime has an advantage on its side, because it knows the subcontractor can only sell that product to the prime. A way for the government to have more control over a subcontractor is by contracting with the subcontractor and providing the items as government-furnished equipment (GFE) (Dominy et al., 2011). The next section considers the contractor's view of DoD profit policy.

### **Contractor's View on DoD Profit Policy**

DoD profit policy provides guidance for profit contractors receive. Profit policy came about due to a belief of significant profits earned by defense contractors. After World War I, the Vinson-Trammel Act of 1934 set limits on contractor profit and then again with the Renegotiation Act of 1942. Later on, the government used past profit rates to negotiate contractor profit in the 1950s. Then in 1964, the government implemented the Weighted Guidelines (WGL) (Davis, 1995). "The WGL focus on three primary factors: Performance Risk, Contract-type Risk, and Facilities Capital Employed" (Davis, 1995, p. 93). The WGL is required to negotiate profit for most contracts-except for cost-plus-award-fee contracts and is only meant to be used as a negotiation reference. A study conducted by James Davis concluded that most defense contractors do not hold favorable views of the WGL (Davis, 1995).

Defense contractors gave many negative responses concerning the WGL when responding to questions posed by researcher James Davis. One sign that contractors do not have a favorable view is that they do not use the WGL when negotiating with other contractors. “Firms felt that the WGL are not relevant for commercial negotiations, since the WGL are not widely used within industry (Davis, 1995, p. 51). Defense contractors do not believe the WGL is set up in a way to incentivize them to continue working with the DoD. One respondent made the comment, “the Government does not use WGL in negotiating unless it is to their advantage. Often WGL will calculate a 10-12% profit and the Government expects us to accept historical percentages which are much lower (8-9%)” (Davis, 1995, p. 73). Davis’s study noted that, “one of the respondents indicated a need to make at least 10-15% profit to stay in business” (Davis, 1995, p. 84). It does not seem to be the case in the contractors’ view that the WGL is helping contractors earn the level of profit they feel they need in the defense market (Davis, 1995). The next topic explores profit percentages earned by defense contractors.

### **Current Profit Percentage**

A study reported in the *Performance of the Defense Acquisition System* (2015) found differences in realized profit margins between primes and subcontractors for both development and production. In regard to development, primes earned 6.2% profit, whereas first-tier subcontractors earned 8.3% profit. The difference was more pronounced on production contracts in which primes only earned 9.0% compared to 16.3% for first tier subcontractors. The study found that primes who control subcontractor profit are also able to control subcontractor costs (*Performance of the*



*Defense Acquisition System*, 2015). The following states how subcontractors fare in terms of profit margins compared to primes for contracts carried out by the three services:

In the production dataset, Navy subcontractors earned systematically lower final margins than the prime contractors. Air Force subcontractors earned final margins comparable to those of the prime contractors. However, Army subcontractors, and subcontractors for prime contractors who had a FFP contract, earned systematically higher final margins than the prime contractors did (*Performance of the Defense Acquisition System*, 2015, p. 123).

The last topic to consider involves costs that primes may not use for calculating profit.

### **Excessive Pass-Through Charges**

The excessive pass-through charges regulation is found in FAR 252.215-22 & 23 and states that contractors may not charge profits for subcontractor work that has no or negligible value. For the contractor to be able to charge profit on these subcontractor costs, it must be added value work. “‘Added’ value means that the Contractor performs subcontract management functions that the Contracting Officer determines are a benefit to the Government (e.g., processing orders of parts or services, maintaining inventory, reducing delivery lead time” (“FAR 52.215,” n.d.). The definition for “no or negligible value” is, “the Contractor or subcontractor cannot demonstrate to the Contracting Officer that its effort added value to the contract or subcontract in accomplishing the work performed under the contract” (“FAR 52.215,” n.d.). “‘Subcontractor’ means any supplier, distributor, vendor, or firm that furnishes supplies or services to or for the Contractor or another subcontractor” (“FAR 52.215,” n.d.). The enforcement of this clause is by the Government Contracting officer. This can substantially raise the profit percentage on a contract for a prime depending on the amount of work they subcontract to another company (“FAR 52.215,” n.d.).

## **Chapter Summary**

This chapter explored the various topics for determining profit percentages earned by contractors. It examined how profits during production are necessary to increase innovation during development. In addition, this chapter discussed the competitive landscape of the defense industry and the relationship between the government and DOD contractors. The next chapter explores the methodology for determining the realized profit percentages of prime contractors and subcontractors for the different acquisition commodities (i.e., aircraft, missiles, and UAVs).

### **III. Methodology**

#### **Introduction**

This chapter discusses the methodology to examine profit margin percentages between primes and subcontractors for the acquisition commodities: aircraft, missiles, and UAVs. It examines the data used and the criteria for determining the data used in the final analysis. Lastly, this section examines the different ways for analyzing prime and subcontractor profit.

#### **Database**

Data for this research comes from The Defense Automated Cost Information Management System (DACIMS), which is part of the Defense Cost and Resource Center (DCARC) (DCARC, n.d.). DCARC was established in 1998 and contains roughly 30,000 Contractor Cost Data Reports (CCDR) (DCARC, n.d.). Cost reporting goes back much further than 1998. The following is a description of DCARC:

DCARC's primary role is to collect current and historical Major Defense Acquisition Program (MDAP) and Major Automated Information System (MAIS) cost and software resource data in a joint service environment, and make that data available for use by authorized government analysts to estimate the costs of ongoing and future government programs. (DCARC, n.d.)

The contractor cost report data is found in the Cost Data Summary Report (CDSR), which is also known as a 1921. There are other types of 1921s in addition to the CDSR such as the 1921-1 (Function Cost-Hour Report), 1921-2 (Progress Curve Report), and 1921-3 (Contractor Business Data Report), but this study only uses data found in the 1921 (CDSR) (*Department of Defense Manual 5000.04-M-1*, 2011). The CDSRs include contractor data such as contract subtotal cost, G&A, undistributed budget, management

reserve, profit, and total contract price (*Data item description “Cost Data Summary Report” (DD Form 1921)*, 2011). DCARC “is the largest central repository of DOD cost information available to the cost community” (DCARC, n.d.). Next, the researchers discuss the data extracted from DCARC that forms the population for this research.

## **Population**

DOD acquisitions are comprised of various sectors, to include aircraft, electronic/automated software, missiles, ordnance, ships, space, surface vehicles, system of systems, and unmanned aerial vehicles. Applicable contract data is comprised of the following acquisition commodities: aircraft, missiles, and UAVs. The analysis of this data compares profit percentages between primes and subcontractors.

The first step of collecting data from DCARC involved running a query. The researchers filtered the query on the following options: commodity, data type, report type, and prime/sub. The data type selected was “1921” and the report type was “Final.”

The screenshot shows a software window titled "Edit/Run Query". At the top right, it says "Total Reports: 413". Below this is a table with two columns: "Filter" and "Selections". The table contains four rows of filter settings:

Filter	Selections
Commodity	AIRCRAFT
Data Type	1921
Report Type	Final
Prime/Sub	Sub

Each row has a small "X" button to its right. Below the table is a large empty rectangular area. At the bottom of the window are two buttons: "Run" and "Cancel".

**Figure 1: DCARC Query**

The DCARC query extracts the cost data that is in DACIMs. Next, the researchers compiled the data for the three commodities into Excel®. The researchers compared CDSR data to the DACIMS library to determine the phase for each CDSR data line. The researchers were interested in data listed as either Development or Production. After checking the phase of each CDSR, the researchers eliminated data in the DACIMS library listed as Sustainment, N/A Govt. effort, or any CDSRs not found in the DACIMS library. While comparing the queried data to the DACIMS library, the researchers verified whether each CDSR represented a prime or sub. The researchers corrected CDSR data originally extracted from the query under sub to prime if listed in the DACIMS library as prime. This happened in a few instances when the DACIMS library

showed two contractors listed as the prime, but one of the contractors showed up as a sub after data export. Another instance of changing subs to prime occurred when a program listed the prime as two companies together, but listed them as subs when shown individually. In this case, the researchers changed the designation of the two contractors listed individually to prime and eliminated the CDSR data that listed the contractors together.

Next, the researchers eliminated CDSR data that showed duplicated costs. In this case, researchers retained only one set of CDSR costs if there were two CDSRs originally with the same cost data. Other data eliminated were CDSRs that combined two or more CDSRs. Cases of this included CDSRs with the following report names: Combined, Total Report, or Summary. The reason for eliminating combined CDSRs was to eliminate the issue of combining two or more CDSRs with different contract types (i.e. fixed and cost-reimbursable).

Next, the researchers verified that the data was in thousands. According to DI-FNCL-81565C, CDSR costs are in thousands (*Data item description "Cost Data Summary Report" (DD Form 1921), 2011*). The researchers verified that data was in thousands by checking to see if the Price At Completion was greater than \$1,000,000. If a CDSR costs were greater than \$1,000,000 then researchers opened the CDSR worksheet from the DACIMS library to verify the values were correct. If the contractor costs were not in thousands but in whole dollars, the researchers created a new line in Excel® by dividing the original CDSR data by one thousand.

Next, the researchers checked Fee At Completion listed between \$-100 and \$100 on the extracted data to ensure there was not a mistake. There were instances of

profit listed as \$0 because either a sub had multiple CDSRs for a contract and, only recorded fee/profit on one CDSR. Another case involved contractors performing work as both the prime and sub on a contract, and only recording profit on the prime CDSR. In these cases, Fee At Completion was combined by creating a new data line in the researchers' database and adding the data lines together for subs that recorded fee on only one CDSR. If a prime also did work as a sub on a contract, the researchers created a new data line, and added the sub's costs together with the prime's costs when it was the same contractor and labeled the new line as prime.

Next, the researchers examined the POP start and end dates to ensure they were correct. If a POP start date was before 2000 or a POP end date was after 2016, the researchers verified these dates by accessing the CDSR worksheet file in the DACIMS library and confirmed the dates matched. In some cases, the dates did not match and the researchers corrected the POP dates in their database to match the CDSR worksheet. Next, the researchers selected the "Search Program" button in the "Charts and Analytics" portion of CADE Portal to assign each CDSR to a service: Air Force, Army, or Navy. Then, the researchers assigned a standardized contractor name for each CDSR line since each contractor was not listed the same. There were variations to the contractor's name, such as some having their address attached to their name in the data extraction. Another step for finalizing the data involved assigning a contract designation for each CDSR line based on the original contract code associated with each CDSR after data extraction. The researchers labeled CDSRs as *Fixed* to designate Fixed Price Contracts, *Cost* to designate Cost Reimbursement Contracts, or *Other* for any other type of contract.

The following chart shows the contract designation in the blue field for analysis based on each original contract code:

Cost Reimbursable	Fixed	Other
Cost Plus	FFP	CPAF/FF
CP	FFI	CPFF & FFP
CPAF	FFP-FF	CPFF/CPAF/FFP/FPIF
CPAF, CPIF	Firm Fixed Price	CPFF/CPAF/FFP/FPIF
CPFF	Firm Fixed Price/IWA	CPFF/FFP
CPFF/CPAF	Fixed Firm Price	CPIF/AF
CPIF	Fixed Price	CPIF/FPIF
CPIF(PI)	FP	FFP/CPFF
CPIF, CPFF	FP/EPA	FPIF/CPFF
CPIF/CPFF	FPI	FPIF/CPFF/FFP
CY	FPI/FFP	FPIF/CPIF
	FPIF	FPIF/FFP/CPFF
	FPIF & FFP	IWTA-C
	FPIF/FFP	IWTA-FWP
	FPIFT(PI)	Letter/CPIF
	FR	MC
		MC(5)
		NA
		OC

**Table 1: Contract List**

Next, the researchers corrected contract numbers that did not appear consistent with other contracts. Then the researchers checked to see if Subtotal To Date and Subtotal At Completion were missing. If they were missing, the researchers collected those missing cost values from the WBS Element 1.0 of the respective CDSR to fill in the missing cost data. Lastly, the researchers calculated the cost completion percentage for each CDSR line. A 1921 (CDSR) is 'Final' when more than 95 percent of costs have been incurred (*Department of Defense Manual 5000.04-M-1*, 2011). The researchers



excluded data that was not between 95-100% complete. This resulted in the elimination of 32 prime CDSRs and 14 subcontractor CDSRs that had cost completion percentages below 95%. There were nine prime CDSRs eliminated along with six subcontractor CDSRs for having a completion percentage above 100%. The researchers eliminated CDSRs with costs above 100% complete due to using Costs Incurred at Completion to calculate profit percentage.

**Cost Completion Percentage Formula:**

$$\frac{\text{Subtotal Costs} + \text{G\&A (Costs Incurred to Date)}}{\text{Subtotal Costs} + \text{G\&A} + \text{UB (Costs Incurred at Completion)}}$$

Where

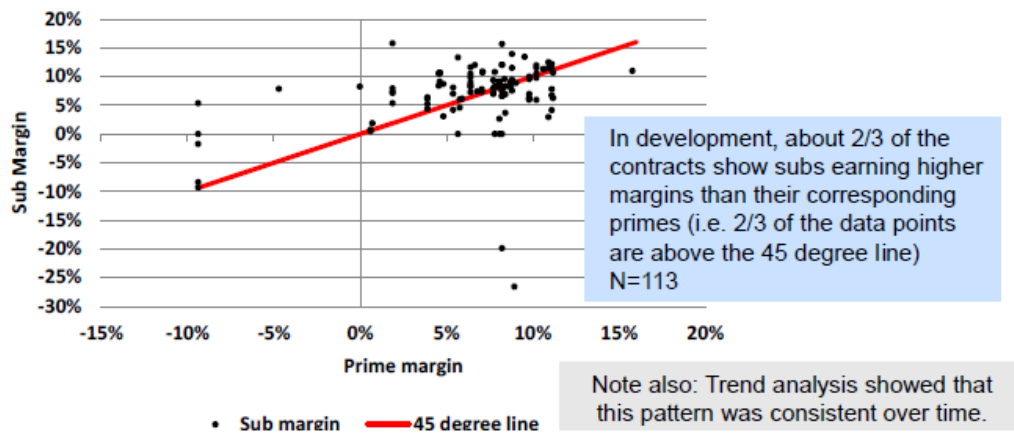
- Subtotal costs: “Total cost provided by the highest level WBS Reporting Element” (*Data item description “Cost Data Summary Report” (DD Form 1921), 2011*)
- General & Administrative (G&A): “Indirect expenses related to the overall management and administration of the contractor’s business unit” (*Data item description “Cost Data Summary Report” (DD Form 1921), 2011*)
- Undistributed Budget (UB): “Portion of the budget applicable to program effort that has not yet been allocated to control account budgets” (*Data item description “Cost Data Summary Report” (DD Form 1921), 2011*)

This research utilized similar data used in the study, *Analysis of Subcontractor Margins*, presented in the Performance of the Defense Acquisition System, 2015, which compared profit margins for primes to subcontractors. The study consisted of 113 subcontracts and 37 prime contracts for development, and 44 subcontracts and 27 prime contracts for

production. The *Analysis of Subcontractor Margins* report mostly compared the overall prime profit percentage for development and production contracts to the profit percentages for the subs for each service and the subcontractors for each prime contractor (*Performance of the Defense Acquisition System*, 2015). Figures 2 and 3 show some of the profit analysis from the study, *Analysis of Subcontractor Margins* (*Performance of the Defense Acquisition System*, 2015, pp. 119 & 121).

**Figure 3-11. Paired Subcontractor and Prime Contractor Final Margins: Development**

*Subcontract Final Margins by the Final Margins Earned by Their Prime Contract: Development (2000–2015)*



**Figure 2: Analysis of Subcontractor Margins (Figure 3-11)**

**First-Tier Subcontractor Final Margins by Prime Contractor in Production**  
(weighted by spending; 2001-2015)

Category	n	Median (%)	Q1 (%)	Q3 (%)	Min (%)	Max (%)	Relative to Prime
Prime margins	27	9.0%	8.5%	16.5%	-10.0%	23.5%	Baseline
A's sub margins	7	9.4%	-5.5%	10.5%	-6.0%	30.0%	Higher
B's sub margins	20	20.2%	9.5%	22.5%	-6.0%	30.0%	Higher
C's sub margins	5	14.0%	12.5%	15.5%	8.5%	17.0%	Higher
D's sub margins	4	0.0%	-0.5%	0.5%	-0.5%	17.5%	Lower
E's sub margins	6	10.3%	9.0%	13.5%	8.5%	23.5%	Higher
H's sub margins	2	17.9%	17.0%	18.5%	16.5%	19.0%	Higher
I's sub margins	4	17.8%	17.0%	18.5%	12.5%	19.0%	Higher
J's sub margins	2	28.5%	28.0%	29.0%	28.0%	29.0%	Higher

ference between the analysis of this research and the *Analysis of*

32

(*Performance of the Defense Acquisition System*, 2015). The research in this study presents the median profit percentage without weighting. The researchers discovered these differences through correspondence with the researcher of the *Analysis of Subcontractor Margins*. The next section presents the methodology for examining the CDSR data.

### **Calculations/Business Case Analysis**

The researchers analyzed profit margin percentages between primes and subcontractors for aircraft, missiles, and UAVs. There are two ways to refer to contractor profit, either as “profit” or as “fee.” Typically, “fee” is the amount contractors receive on cost-reimbursable contracts and “profit” is what contractors receive on fixed-type contracts. This study combines the two terms and refers to them as “profit” to signify the profit received by contractors (“Cost Reimbursement Contracts,” n.d.). There are various ways to calculate profit percentage. The typical profit margin calculation is profit over sales (revenue), but the Government calculates profit margin as profit over contract costs (Arnold, Harmon, et al., 2009). The researchers calculated profit as a lower bound and an upper bound using Costs Incurred At Completion data for each contract type based on profit over costs. The main analysis presents profit percentages calculated using the lower bound equation, but the appendix shows profit percentages calculated with both the lower bound and upper bound equations for completeness. Management reserve (MR) is either included in the numerator or denominator or excluded all together from a formula due to not knowing whether there will be any remaining MR at the end of a contract. The

reason for this is that there is uncertainty in regards to MR before completion reaches 100%.

$$\text{Lower Bound (Cost \& Other Contracts)} = \frac{\text{Profit}}{\text{Subtotal Cost} + \text{G\&A} + \text{UB} + \text{MR}}$$

$$\text{Upper Bound (Cost \& Other Contracts)} = \frac{\text{Profit}}{\text{Subtotal Cost} + \text{G\&A} + \text{UB}}$$

$$\text{Lower Bound (Fixed Contracts)} = \frac{\text{Profit}}{\text{Subtotal Cost} + \text{G\&A} + \text{UB}}$$

$$\text{Upper Bound (Fixed Contracts)} = \frac{\text{Profit} + \text{MR}}{\text{Subtotal Cost} + \text{G\&A} + \text{UB}}$$

Where

- Management Reserve: “Total allocated budget that is held back for management control and risk purposes at the total contract level” (*Data item description “Cost Data Summary Report” (DD Form 1921), 2011*).

The researchers show the differences in median profit percentages between prime contractors and subcontractors with box plots and box charts. The box plots also show the 10<sup>th</sup>, 25<sup>th</sup>, 75<sup>th</sup>, and 90<sup>th</sup> quartile values, along with the ranges. The researchers used median instead of mean because the mean can be skewed by outliers (McClave, Benson, & Sincich, 2014). In addition, the researchers present the min/max, average, and weighted average of profit percentages as calculated by the lower bound and upper bound

equations in the appendix. Below are the breakouts for showing the differences between profit percentage for prime contractors and subcontractors:

- 1.) Prime versus Sub (Overall)
- 2.) Acquisition Phase
  - Development & Production
- 3.) Contract Type
  - Cost Reimbursable, Fixed & Other
- 4.) Service
  - Air Force, Army, & Navy
- 5.) Commodity
  - Aircraft, Missiles, & UAVs

Next, the researchers created scatter plots showing median profit percentages on the y-axis and its respective CDSR cost on the x-axis. The CDSR costs were the values used in the denominator of the lower bound profit equation. Since these costs were not all in the same year, they were escalated to Constant Year (CY) 2015\$ based on the year assigned to a CDSR by the researchers as determined by its POP and its phase (production or development). The researchers used the PCU3364, “aerospace product and parts manufacturing,” located on the Bureau of Labor Statistics website for escalation. The researchers did not apply an escalation factor to two CDSRs assigned the year 2016 since the last full year with price indices was 2015. The following equations show how a year was assigned to a CDSR so that it could be escalated to CY2015\$.

$$Year (Production) = POP Start Year + 1$$

$$Year (Development) = \frac{POP \text{ Start Year} + POP \text{ End Year}}{2}; \text{rounded down}$$

The earliest POP start date for the data was 1992 and the latest POP start date was 2015. Since production efforts typically last three years, the researchers added a one to the POP start date with the assumption that acquisition programs spend the majority of their money for a contract in the second year. The researchers determined the year for analysis of development CDSRs by adding the POP start and end date together and dividing by two, then rounding down.

Lastly, the researchers removed a couple of outliers from either all of the analysis or some of the analysis. One of the data points removed was a prime CDSR with profit of 1425.9%. The researchers removed this data point for being a significant number of standard deviations from the rest of the data and that no other CDSR had profit above 100%. The main reason for its removal was due to a significant contract modification on the effort in which the researchers do not know the reasons for the changes, which makes this effort not representative of a “typical” contract. The research team removed this CDSR from all analysis that included development, cost reimbursable, aircraft, or Navy CDSRs. Another data point removed was a prime CDSR with a cost of \$12.7B and 0% profit. The researchers removed this point from scatter plots that included production, fixed contract, aircraft, or Navy CDSRs. The researchers removed this point because of being considerably farther away from the rest of the data by a few billion dollars. After further review, the researchers believe that the profit reported on this CDSR may be

incorrect after comparing it to other CDSRs related to this effort that are in DACIMs, but were not in the data query extraction. The researchers left this data point in the analysis except for the scatter plot because of not knowing for sure whether it is incorrect or not.

## **Summary**

The researchers discussed in this chapter the database used for collecting the data to compare profit margin percentages between primes and subcontractors for aircraft, missiles, and UAVs. It discussed the methodology for how researchers present the median profit percentages of primes and subcontractors to discern if there are any differences between the two when broken down by phase, contract type, commodity, or service. The next chapter presents the calculations and results of the analyzed data.



## IV. Analysis and Results

### Chapter Overview

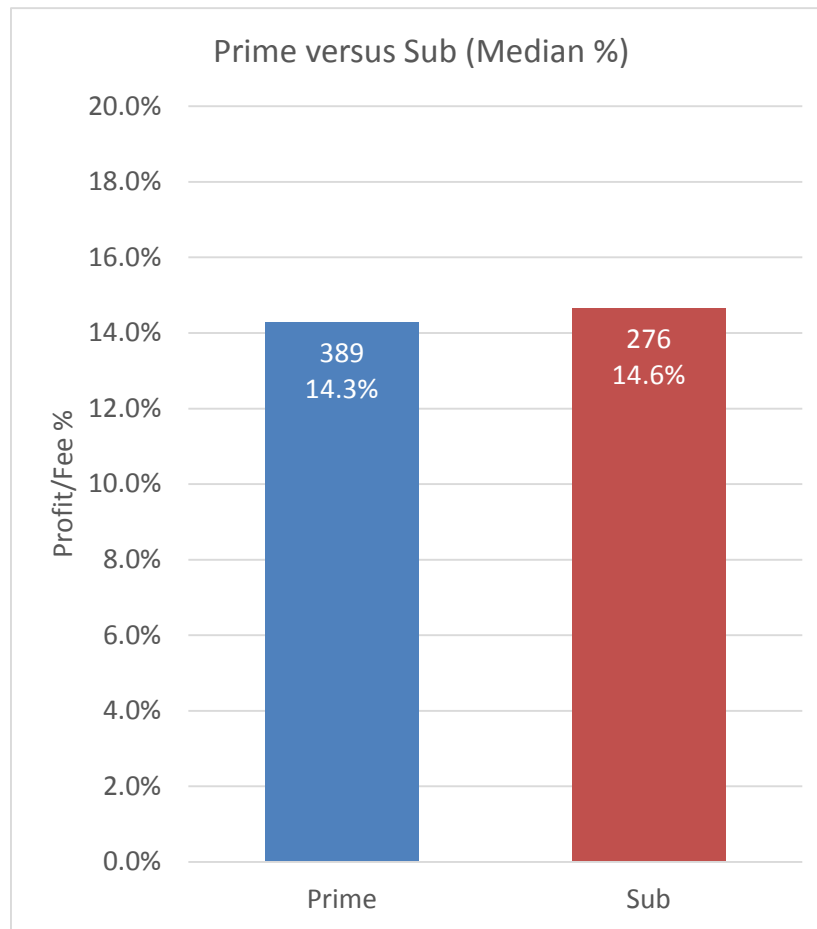
The researchers in this chapter present the results of prime and subcontractor profit for the various categories: phase, contract type, commodity, and service. The researchers used the lower bound profit percentage to present contractor profit. Overall, this study analyzed 665 CDSRs with 389 of those being prime CDSRs and 276 being subcontractor CDSRs.

### Prime/Subcontractor CDSRs

This section shows a comparison of prime and subcontractor profit for all 665 CDSRs used in this study. The researchers show whether one group receives a higher profit percentage over the other. The researchers analyzed the difference in profit between the two with bar charts, scatter plots, and box plots. There are different ways to calculate contractor profit before all costs are truly final because of uncertainty with management reserve. The researchers present profit percentages in this chapter using the lower bound equations from chapter 3 to represent what the researchers believe to be the most likely minimum profit received by contractors. As stated in chapter 3, other contracts encompass contracts that are a combination of cost reimbursable contracts and fixed-price type contracts.

$$\text{Lower Bound (Cost \& Other Contracts)} = \frac{\text{Profit}}{\text{Subtotal Cost} + \text{G\&A} + \text{UB} + \text{MR}}$$

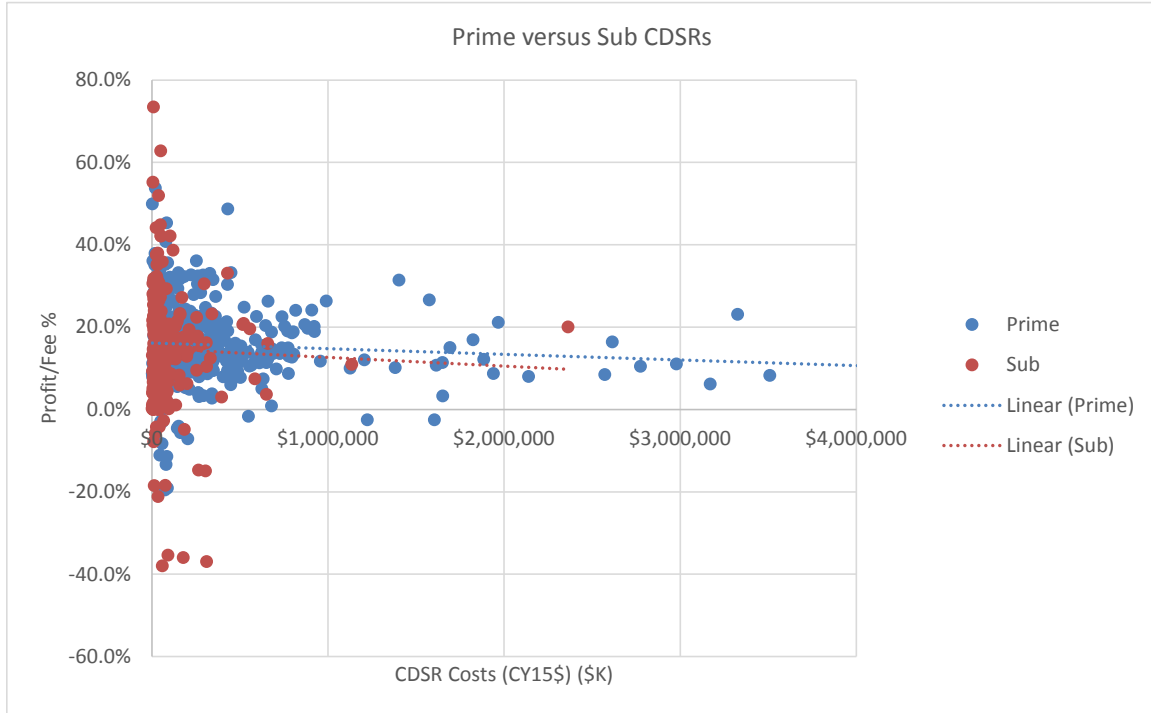
$$\text{Lower Bound (Fixed Contracts)} = \frac{\text{Profit}}{\text{Subtotal Cost} + \text{G\&A} + \text{UB}}$$



**Figure 4: Prime versus Sub (Bar Chart)**

Figure 4: Prime versus Sub (Bar Chart) displays the median lower bound profit percentage for primes and subcontractors. The chart shows a minimal difference (0.3%) in median profit percentage between the two groups. The results from this graph show that the median profit received by primes and subcontractors tends to be the same and that there is no advantage in terms of profit for either group. The next chart is a scatter

plot, which displays all of the profit percentages between primes and subcontractors for this study.



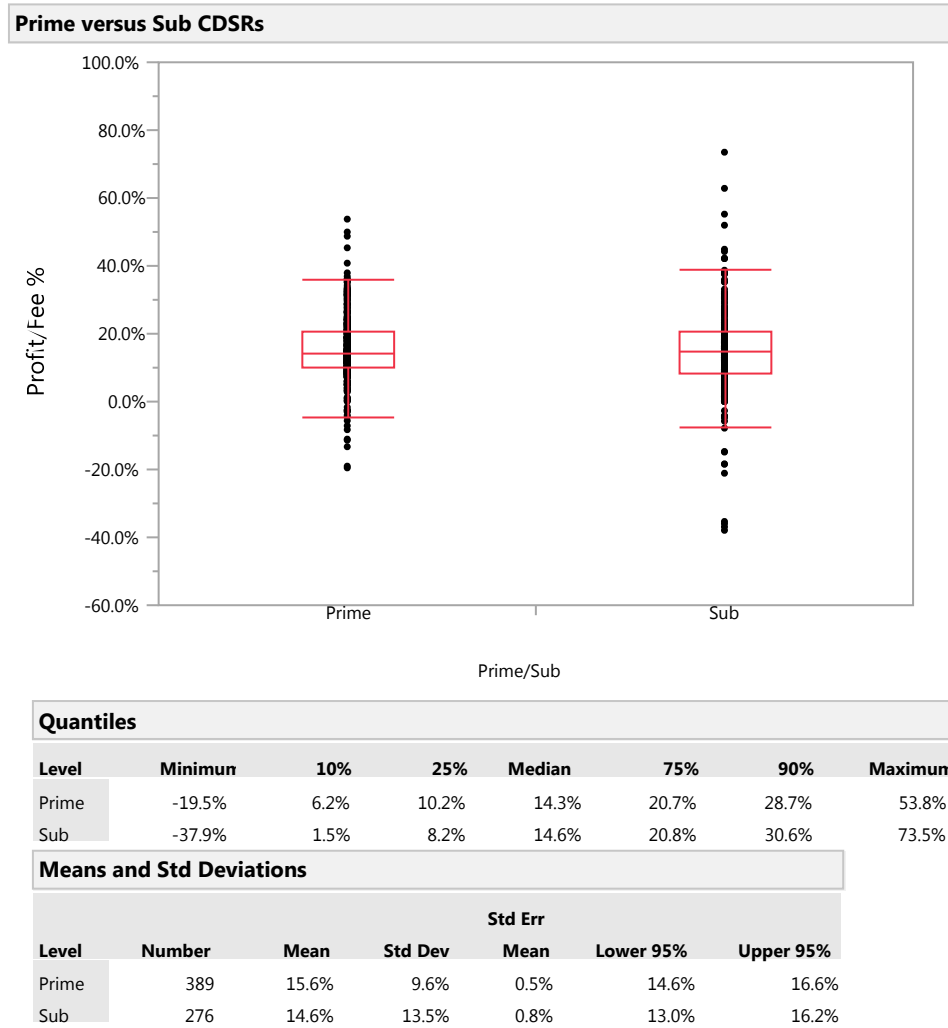
**Figure 5: Prime versus Sub (Scatter Plot)**

Figure 5: Prime versus Sub (Scatter Plot) displays contractor profit on the y-axis as calculated from the lower bound equation and its respective CDSR cost on the x-axis based on the denominator of the lower bound equation. The scatter plot shows all of the CDSRs used in this study. To normalize CDSR costs, the researchers escalated costs using the PCU3364 index from the Bureau of Labor Statistics. Below is the calculation for determining the year assigned to a CDSR.

$$Year (Development) = \frac{POP \text{ Start Year} + POP \text{ End Year}}{2}; \text{rounded down}$$

$$\text{Year (Production)} = \text{POP Start Year} + 1$$

Figure 5 suggests that subcontractors have more variability in regards to profit percentage. According to the graph, primes rarely exceed 40% and do not receive losses greater than -20%.



**Figure 6: Prime versus Sub (Box Plot)**

The chart in Figure 6: Prime versus Sub (Box Plot), is a box plot of lower bound profit for all of the CDSRs used in this study. Figure 6 highlights the quantiles for this

data, which includes the median and shows the mean and standard deviation. The table shows that the standard deviation is about 50% greater for subcontractors than primes. The 95% confidence interval for the mean of both primes and subcontractors closely overlaps one another. This suggests that it cannot be determined that the means are different for the two groups, and supports that primes and subcontractors receive similar profit percentages. Below is the calculation for the mean 95% confidence interval.

$$\bar{x} \pm (z(\alpha/2)) \left( \frac{s}{\sqrt{n}} \right)$$

Where

- $\bar{x}$  is the sample mean
- $s$  is the sample standard deviation
- $n$  is the sample size

The formula comes from pg. 305 of *Statistics for Business and Economics* (McClave et al., 2014, p. 305). When  $\alpha$  is 0.05, there is a 95% confidence interval. According to McClave et al., “if our confidence interval is 95%, then in the long run, 95% of our confidence intervals will contain  $\mu$  and 5% will not” (McClave et al., 2014, p. 304). The symbol,  $\mu$ , represents the population mean.

The researchers used the program JMP® to create the box plots in this study. Sometimes data points fall outside the whiskers, which are the outer red horizontal lines on the output. The determination for the end length of the whiskers is as follows:

$$3rd \text{ quartile} + 1.5 * (\text{interquartile range})$$

$$1st \text{ quartile} - 1.5 * (\text{interquartile range})$$

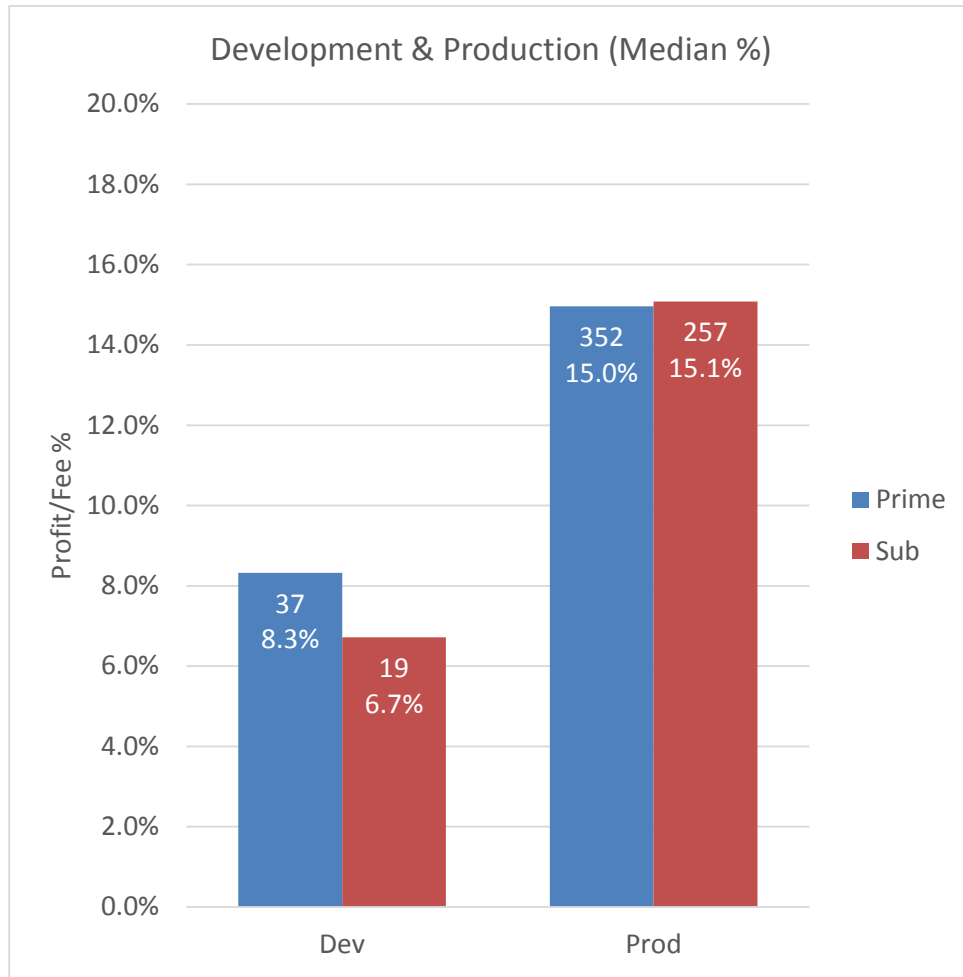
Where

- “The ends of the box represent the 75<sup>th</sup> and 25<sup>th</sup> quantiles, also expressed as the 3<sup>rd</sup> and 1<sup>st</sup> quartile” (JMP, n.d.)

The equations for the end length of the whiskers come from the JMP website. “If the data points do not reach the computed ranges, then the whiskers are determined by the upper and lower data point values (not including outliers)” (JMP, n.d.).

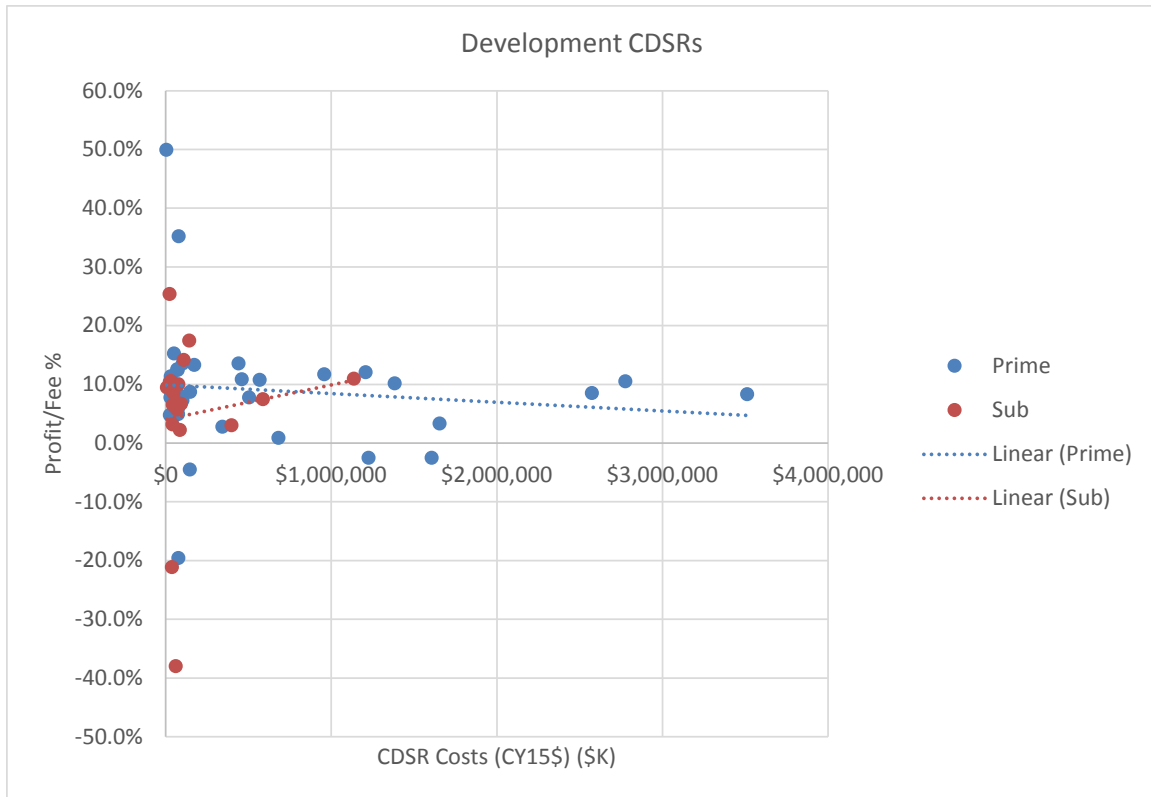
### **Development and Production**

This section is an examination of profit percentage between primes and subcontractors broken down by phase: development and production. The researchers wanted to see what impact the type of acquisition phase has on profit for the two groups.



**Figure 7: Development & Production (Bar Chart)**

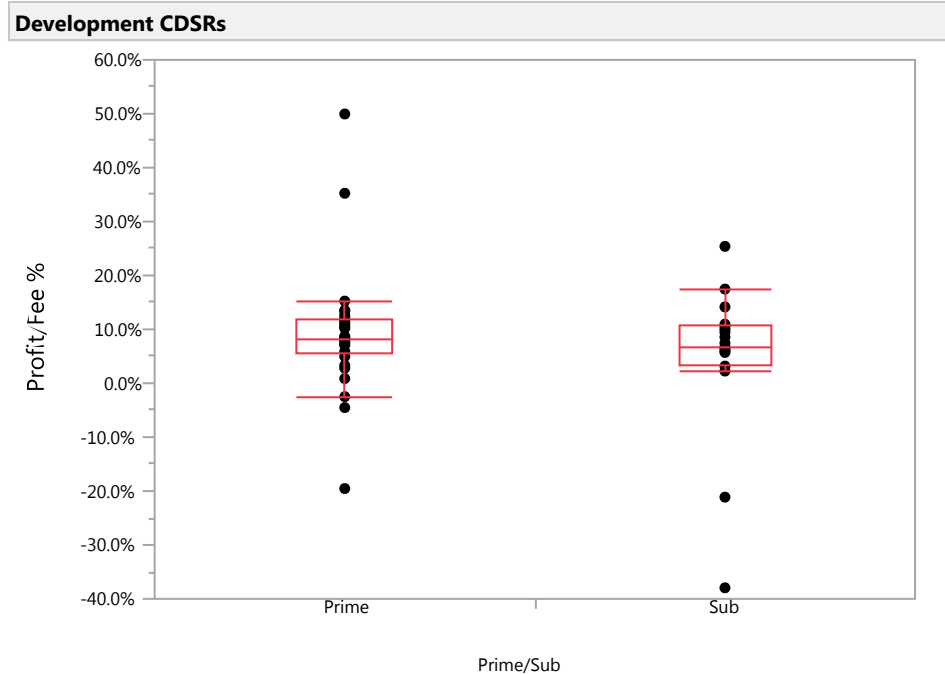
The bar chart above in Figure 7: Development & Production (Bar Chart) shows that contractor profit is about twice as high during the production phase than during the development phase. Profit during production tends to be the same overall between primes and subcontractors. The Government tends to use fixed-price type contracts during production and cost reimbursable contracts during development. On the surface, there is a noticeable difference between prime and subcontractor profit during development.



**Figure 8: Development CDSRs (Scatter Plot)**

Focusing in on Development, the scatter plot in Figure 8: Development CDSRs (Scatter Plot) only shows a few instances when primes and subcontractors lose money on development efforts. The researchers found that the profit percentage for primes does not appear to change as CDSR costs increase. There also appear to be a couple of possible outliers, the prime CDSR with profit of 50% and the subcontractor CDSR with -40% profit.





Excluded Rows 609

Quantiles							
Level	Minimum	10%	25%	Median	75%	90%	Maximum
Prime	-19.5%	-2.5%	5.4%	8.3%	11.9%	13.9%	50.0%
Sub	-37.9%	-21.1%	3.2%	6.7%	10.6%	17.5%	25.4%

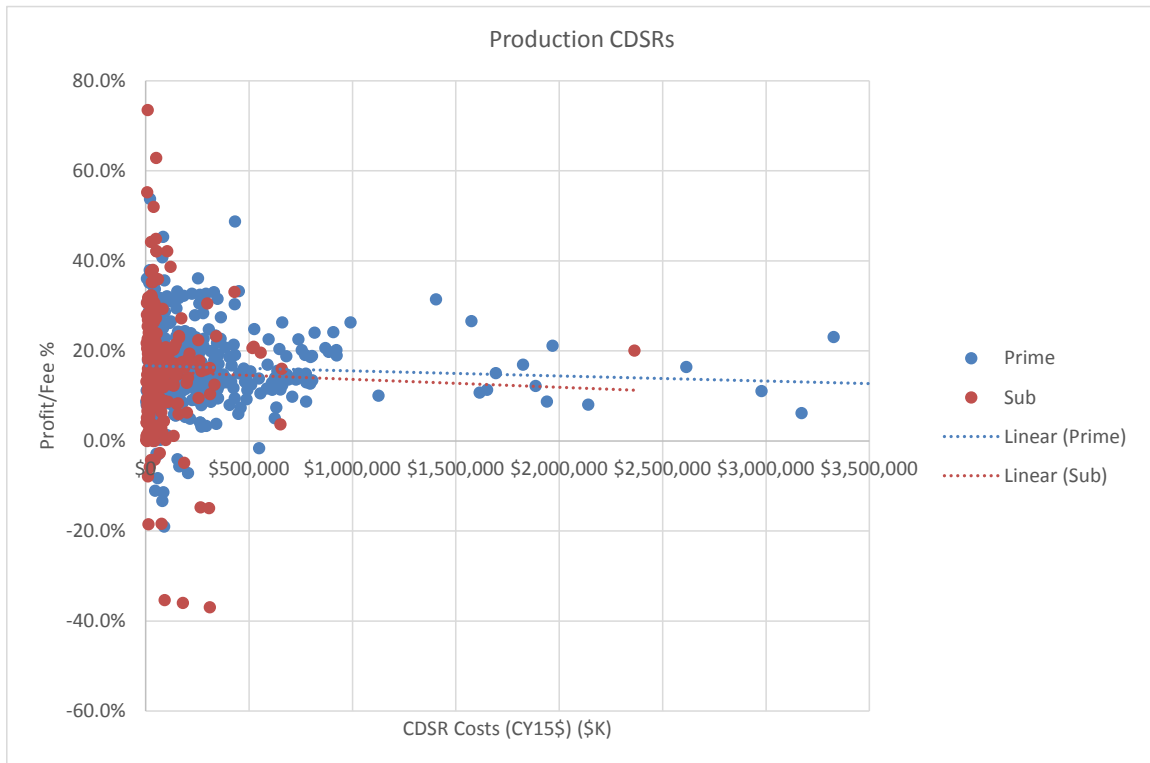
  

Means and Std Deviations						
Level	Number	Mean	Std Dev	Std Err		
				Mean	Lower 95%	Upper 95%
Prime	37	9.1%	10.5%	1.7%	5.5%	12.6%
Sub	19	5.0%	13.6%	3.1%	-1.6%	11.6%

**Figure 9: Development CDSRs (Box Plot)**

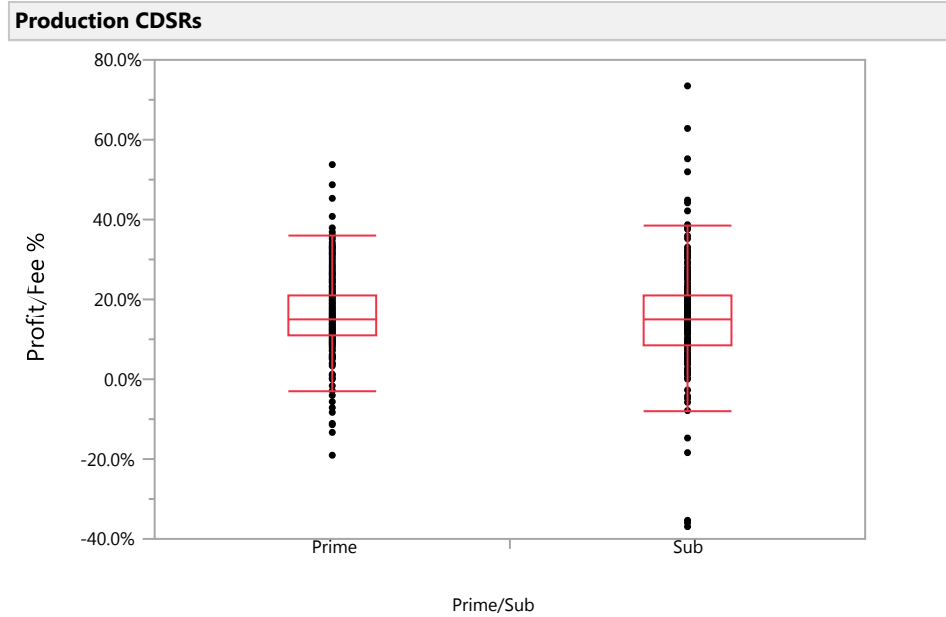
The box plot in Figure 9: Development CDSRs (Box Plot) shows a few outliers for both primes and subcontractors. According to the quantile output, the middle 80% of prime profit falls within a smaller interval than the middle 80% for subcontractors. The mean profit 95% confidence interval for subcontractors overlaps a sizeable portion of the mean profit confidence interval for primes. The overlap of the confidence intervals

prevents the researchers from finding a statistically significant difference in mean profit percentage between the two groups.



**Figure 10: Production CDSRs (Scatter Plot)**

Moving to the next phase, the scatter plot in Figure 10: Production CDSRs (Scatter Plot) shows contractor profit for production efforts. The researchers found greater variation for subcontractor profit percentages. In a few cases, subcontractors had profit ranging from -40% to around 70%, indicating much larger variability in realized profit for subcontractors versus primes. The graph shows that profit for both prime contractors and subcontractors decrease slightly as CDSR costs increase. In addition, prime profit appears less likely to be above 20% when CDSR costs are above \$1.5B.



Excluded Rows 56

**Quantiles**

Level	Minimum	10%	25%	Median	75%	90%	Maximum
Prime	-19.0%	7.6%	11.2%	15.0%	21.2%	28.8%	53.8%
Sub	-36.9%	1.5%	8.5%	15.1%	20.9%	30.8%	73.5%

**Means and Std Deviations**

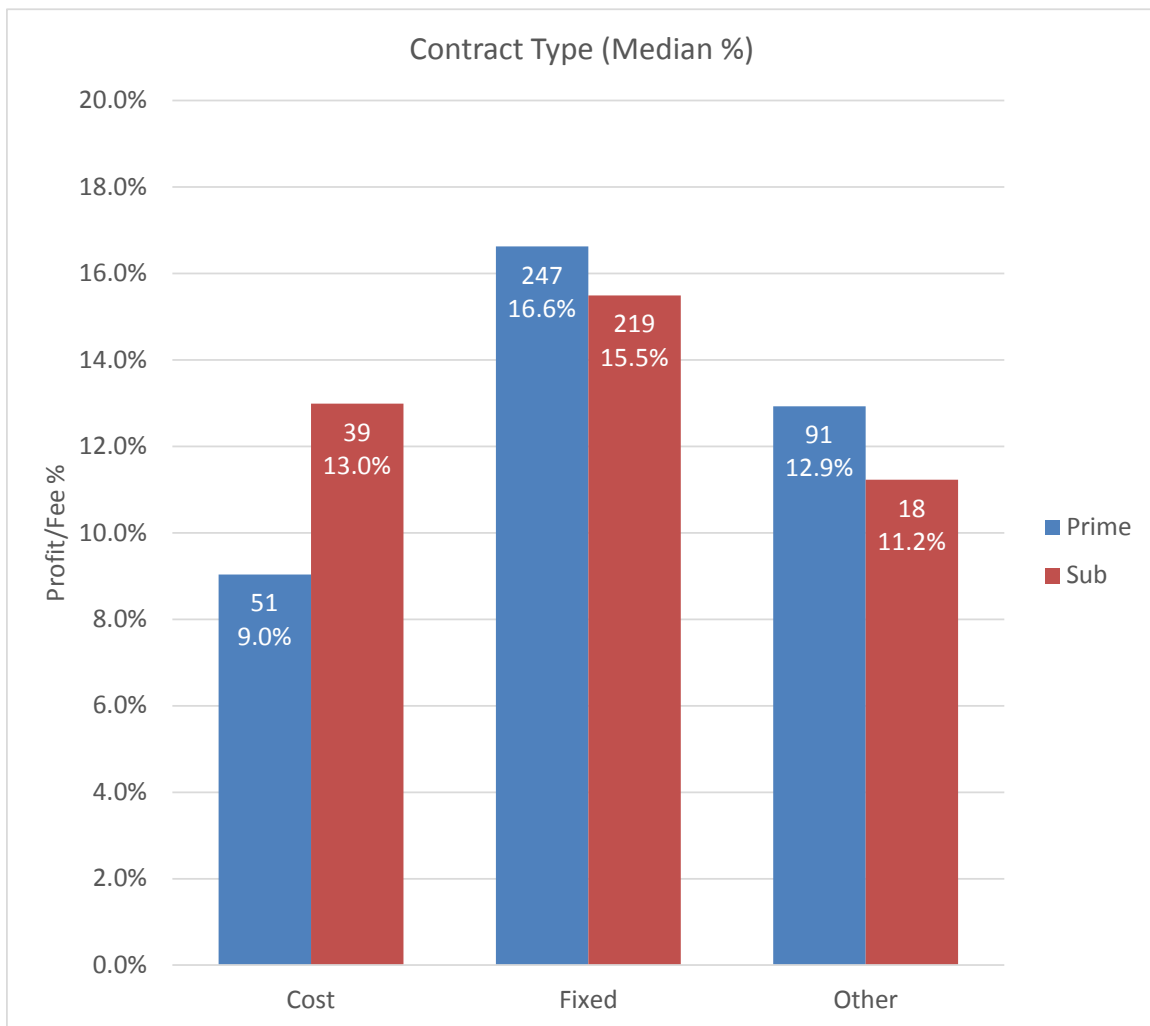
Level	Number	Mean	Std Dev	Std Err		
				Mean	Lower 95%	Upper 95%
Prime	352	16.3%	9.3%	0.5%	15.3%	17.3%
Sub	257	15.3%	13.3%	0.8%	13.7%	16.9%

**Figure 11: Production CDSRs (Box Plot)**

The box plot in Figure 11: Production CDSRs (Box Plot) is another situation that shows the standard deviation is higher for subcontractors than primes. In addition, the box plot shows wider variation for subcontractors. Profit percentages during the production phase tends to be the same between primes and subcontractors as shown by the similar median profit percentage and overlapping mean profit 95% confidence intervals.

## Contract Type

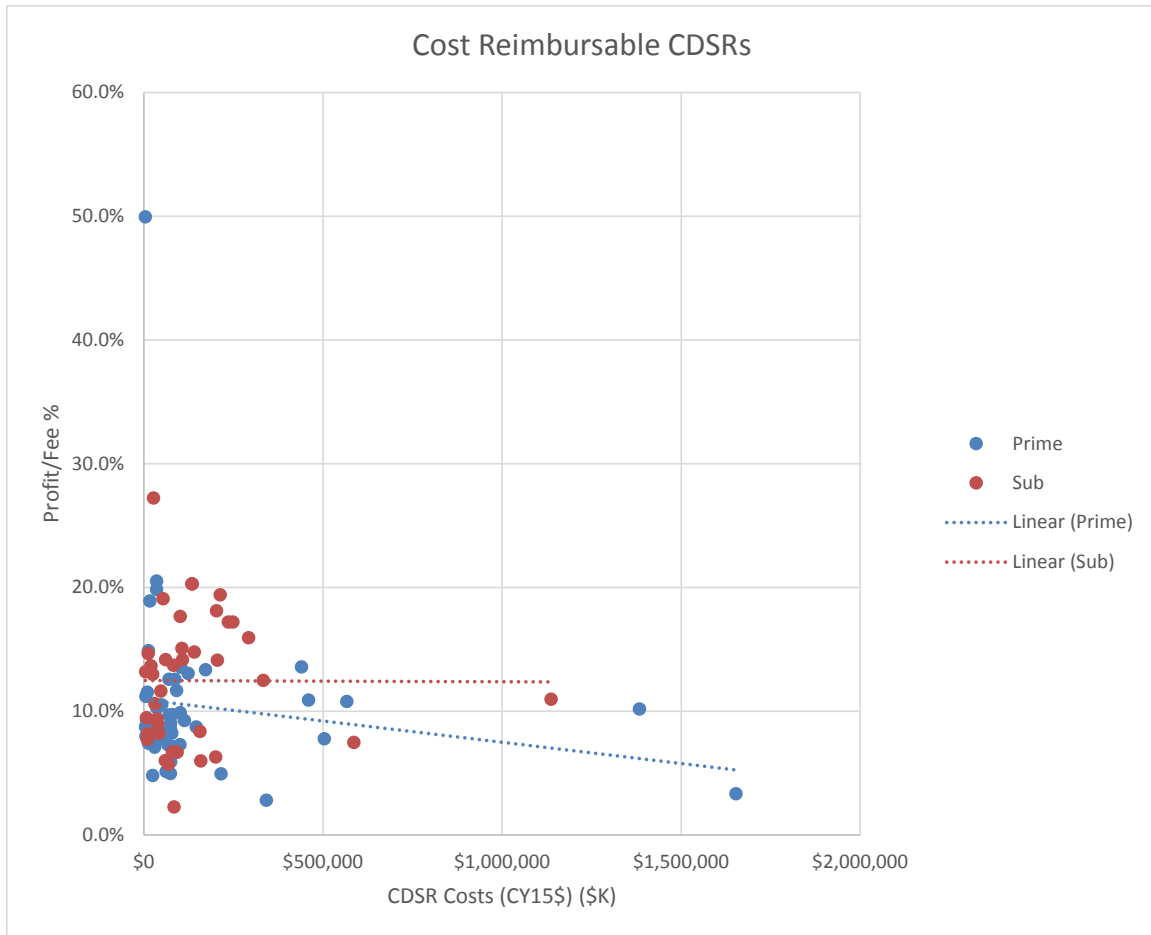
The following charts show contractor profit broken out by contract type: cost reimbursable, fixed, and other.



**Figure 12: Contract Type (Bar Chart)**

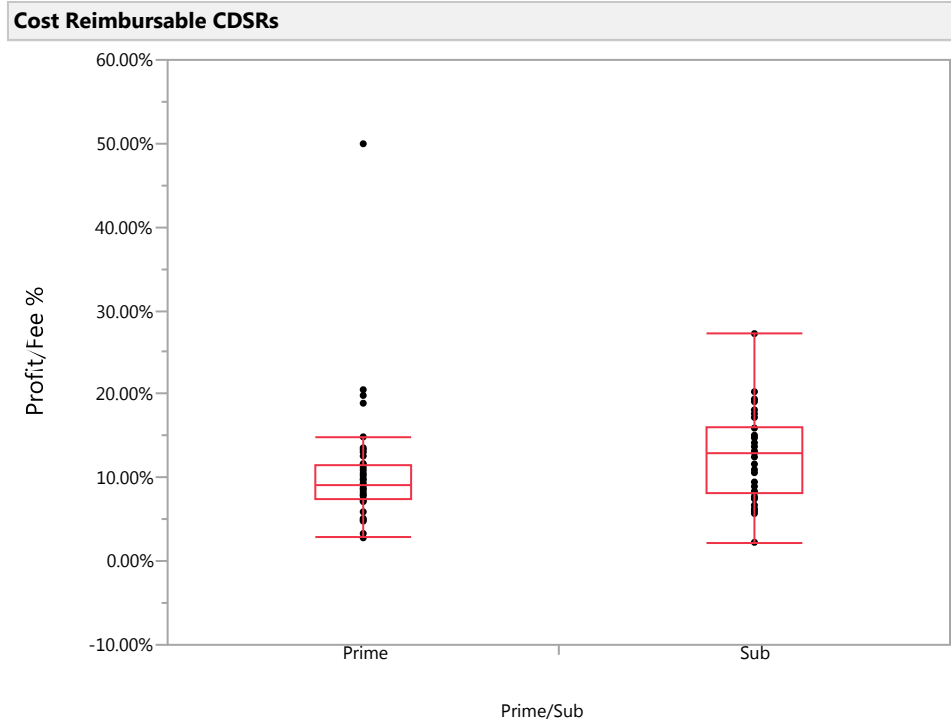
The bar chart in Figure 12: Contract Type (Bar Chart) shows that contractors tend to receive the highest profit percentage for fixed-type contracts. The figure above shows that cost reimbursable contracts are the only case in which subcontractors earn more than

primes for the three types of contracts. Subcontractors may be able to leverage extra profit from prime contractors due to the uncertainty associated with cost reimbursable contracts. Prime contractors have a little more than a 1% profit advantage over subcontractors for fixed contracts. Other type contracts are those contracts that are a mixture of both cost reimbursable and fixed-price type contracts. A note to point out is that the contract type may not be the same between prime contractors and subcontractors for the same effort. For example, a prime may have a cost-reimbursable contract with the Government, but may contract work out to a subcontractor using a fixed-price type contract.



**Figure 13: Cost Reimbursable CDSRs (Scatter Plot)**

The scatter plot in Figure 13: Cost Reimbursable CDSRs (Scatter Plot) shows that subcontractors tend to receive higher profit for cost reimbursable contracts than what prime contractors receive. Subcontractor profit tends not to be a function of the value of a contract as shown by Figure 13. Prime contractor profit is concentrated a little below 10%. None of the contractors in this analysis had negative profit.



Excluded Rows 575

**Quantiles**

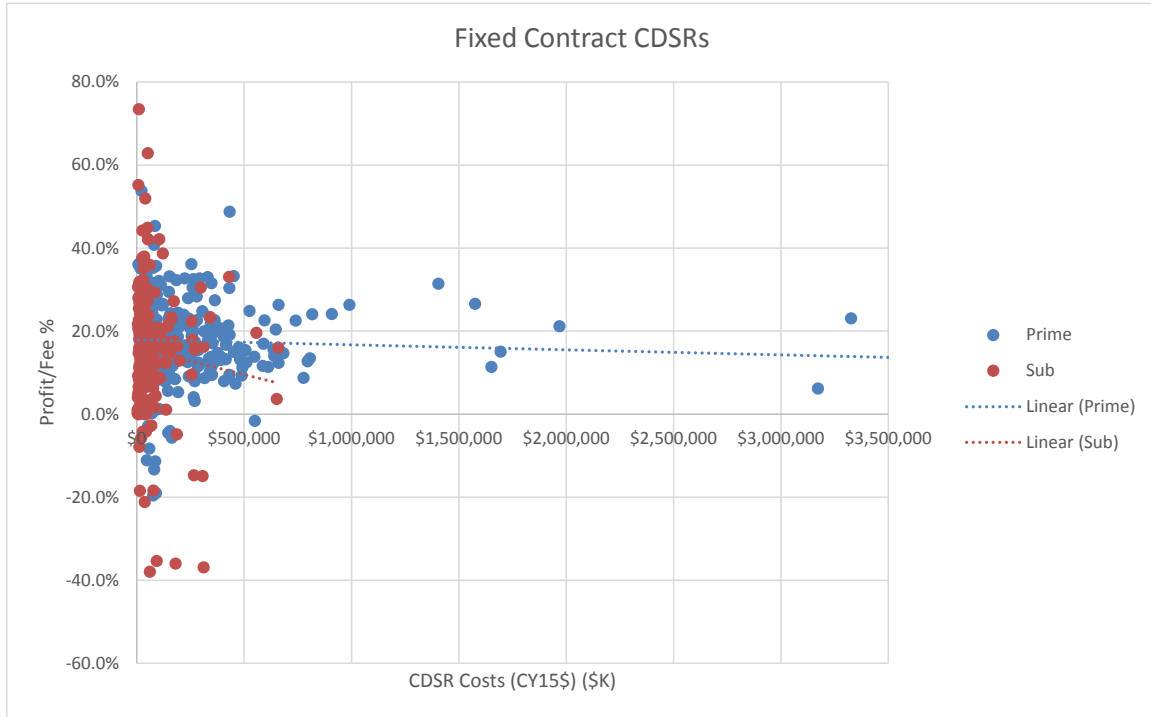
Level	Minimum	10%	25%	Median	75%	90%	Maximum
Prime	2.8%	5.0%	7.4%	9.0%	11.5%	14.6%	50.0%
Sub	2.3%	6.0%	8.2%	13.0%	15.9%	19.4%	27.2%

**Means and Std Deviations**

Level	Number	Mean	Std Dev	Std Err		
				Mean	Lower 95%	Upper 95%
Prime	51	10.4%	6.7%	0.9%	8.5%	12.3%
Sub	39	12.5%	5.3%	0.8%	10.8%	14.2%

**Figure 14: Cost Reimbursable CDSRs (Box Plot)**

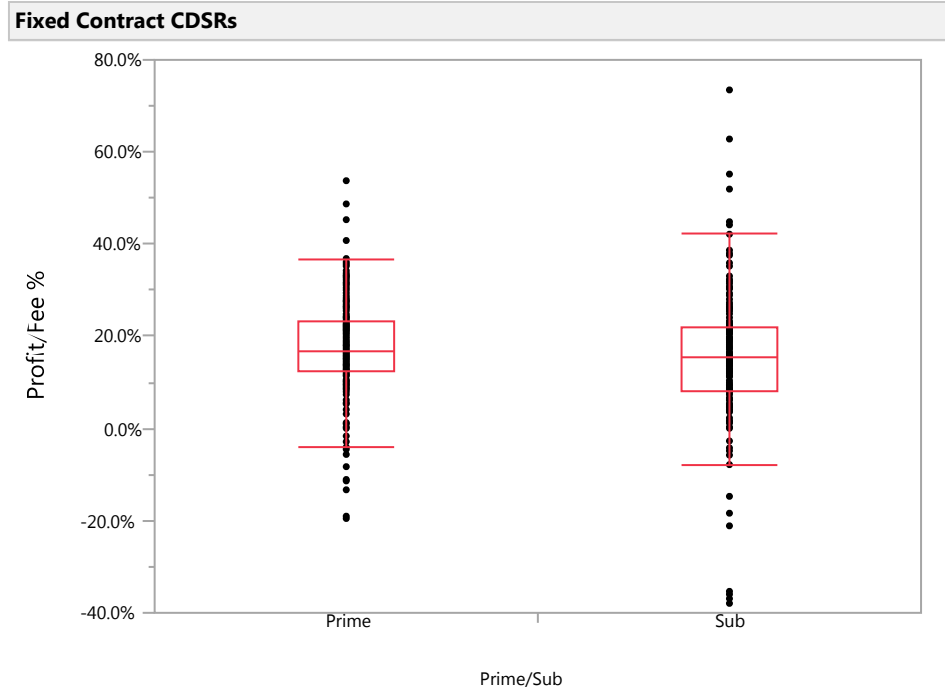
The quantile chart in Figure 14: Cost Reimbursable CDSRs (Box Plot) shows that there is a higher standard deviation for prime profit. This could potentially be a result of the ~50% profit for one of the prime CDSRs. The box plot shows that the concentration of subcontractor data points tends to be higher than the concentration of prime contractor points. Based on the results, there is support to state that subcontractors receive higher profit than primes for cost reimbursable contracts.



**Figure 15: Fixed Contract CDSRs (Scatter Plot)**

The scatter plot in Figure 15: Fixed Contract CDSRs (Scatter Plot) shows higher variation for subcontractor profit. It shows that subcontractors at times experience much higher profit percentage losses than prime contractors. In addition, subcontractors appear to have more cases of profit being above 40% than prime contractors.





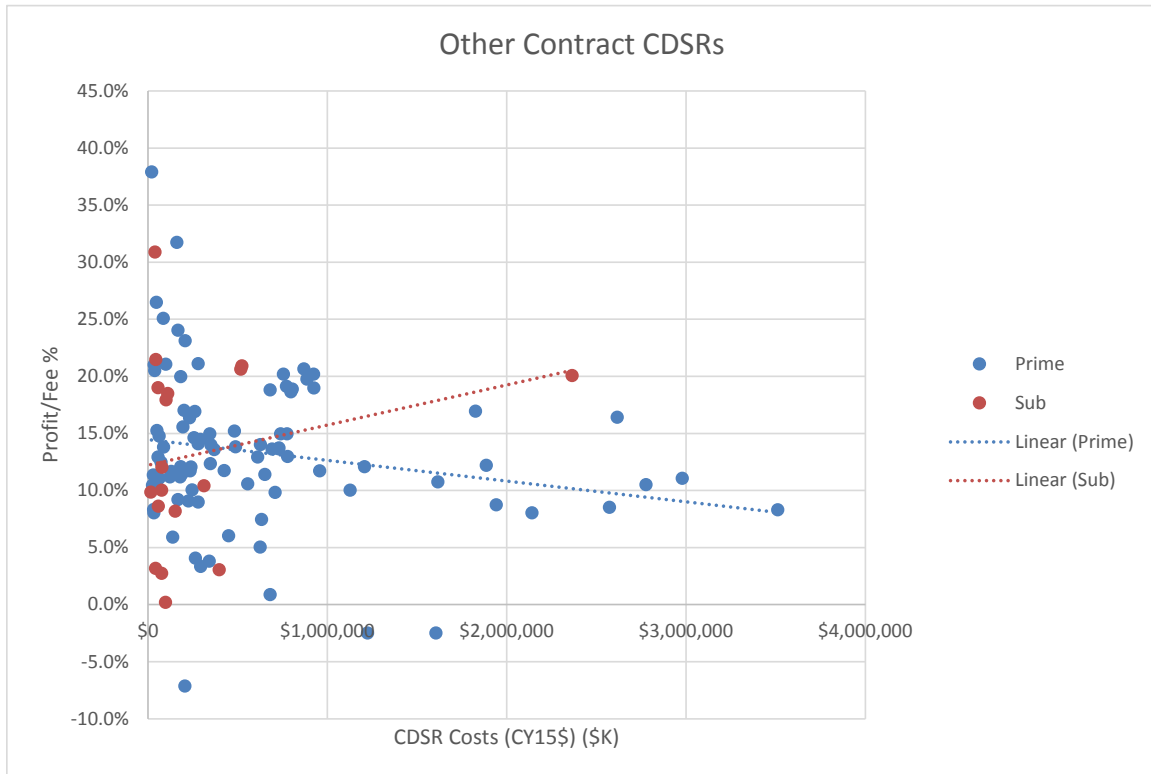
Excluded Rows 199

Quantiles							
Level	Minimum	10%	25%	Median	75%	90%	Maximum
Prime	-19.5%	7.9%	12.4%	16.6%	23.4%	31.5%	53.8%
Sub	-37.9%	0.3%	8.1%	15.5%	22.0%	31.5%	73.5%
Means and Std Deviations							
Level	Number	Mean	Std Dev	Std Err			
				Mean	Lower 95%	Upper 95%	
Prime	247	17.5%	10.5%	0.7%	16.2%	18.8%	
Sub	219	15.1%	14.8%	1.0%	13.1%	17.1%	

**Figure 16: Fixed Contract CDSRs (Box Plot)**

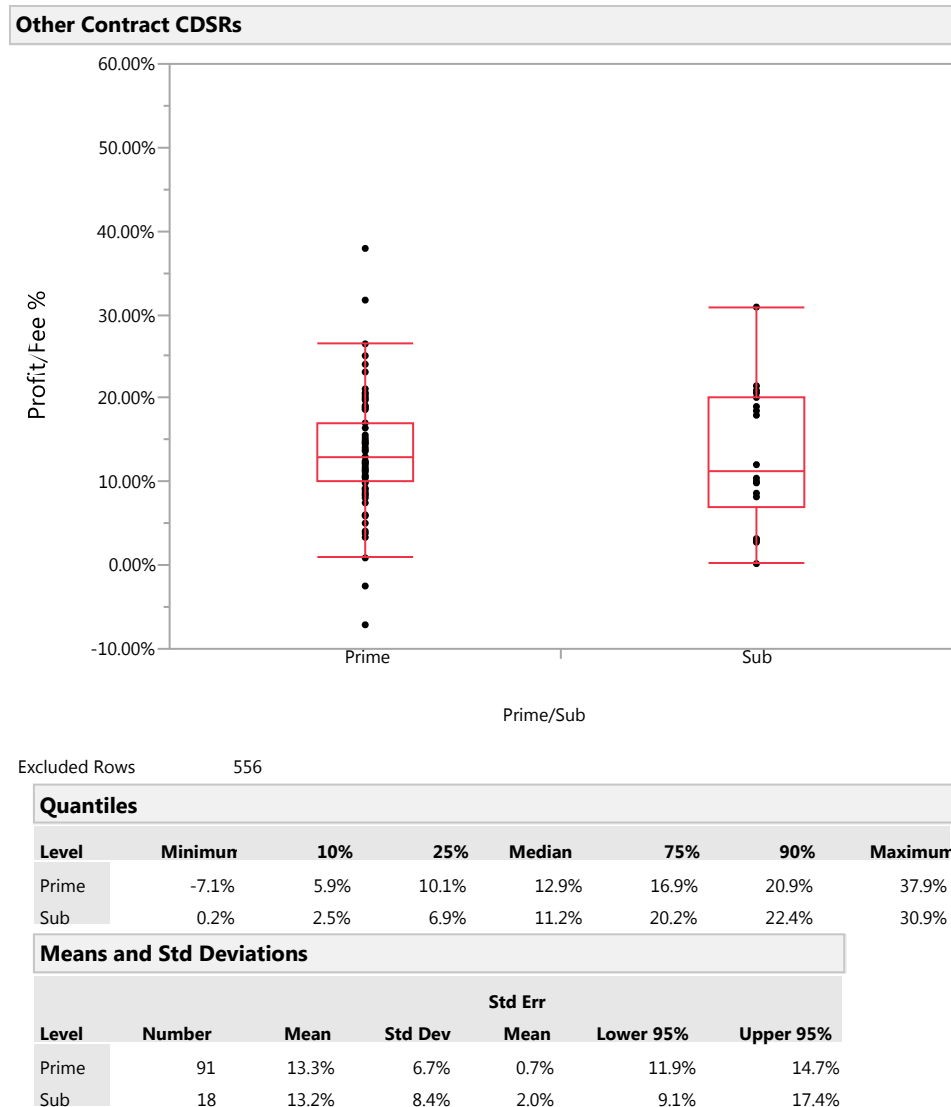
The box plot in Figure 16: Fixed Contract CDSRs (Box Plot) shows greater variation in profit for subcontractors for fixed type contract CDSRs compared to prime contractors. The median profit percentage between the two is only 1% apart, but the mean 95% confidence interval for subcontractor profit is larger than the confidence interval for primes. Based upon Figure 16, there is reason to believe that prime

contractors tend to earn a slightly larger profit percentage than subcontractors do for fixed contracts.



**Figure 17: Other Contract CDSRs (Scatter Plot)**

The scatter plot in Figure 17: Other Contract CDSRs (Scatter Plot) shows a little wider variation for prime profit, but there seems to be wide variation for subcontractor profit too. None of the prime contractors received profit above 20% for CDSRs with costs above \$1B. Cost reimbursable contracts may form a larger portion of the efforts on CDSRs with costs above \$1B, which is a possible reason for these CDSRs having profit below 20%.

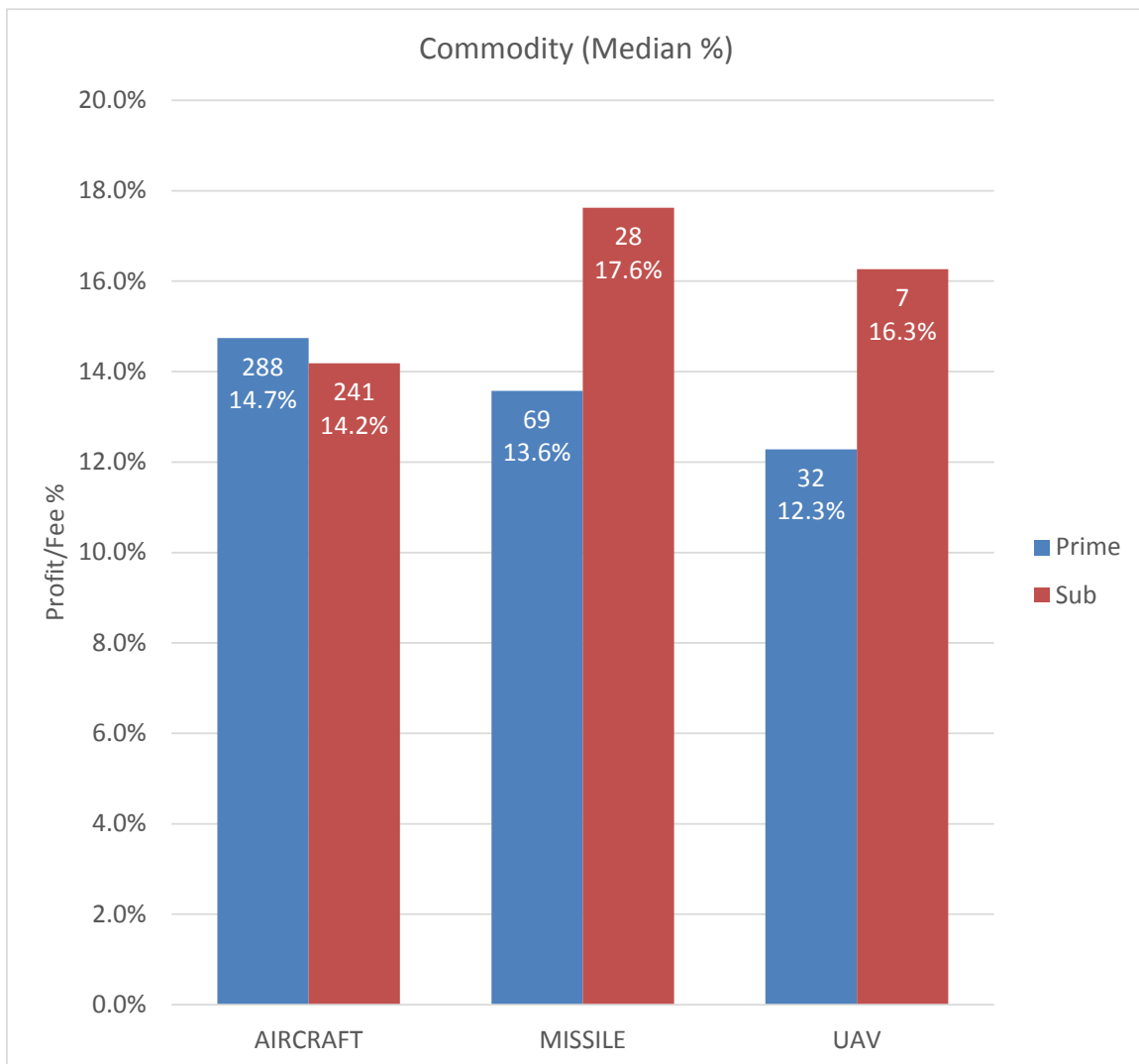


**Figure 18: Other Contract CDSRs (Box Plot)**

Although variation appears larger for primes in Figure 17, Figure 18: Other Contract CDSRs (Box Plot) shows a higher standard deviation for subcontractors. The lower number of subcontractor CDSRs is a possible reason for subcontractors having a higher standard deviation along with a wider mean 95% confidence interval for profit. However, the limited number of subcontractor data points makes it difficult to claim that subcontractors usually receive a lower profit percentage than prime contractors.

## Commodity

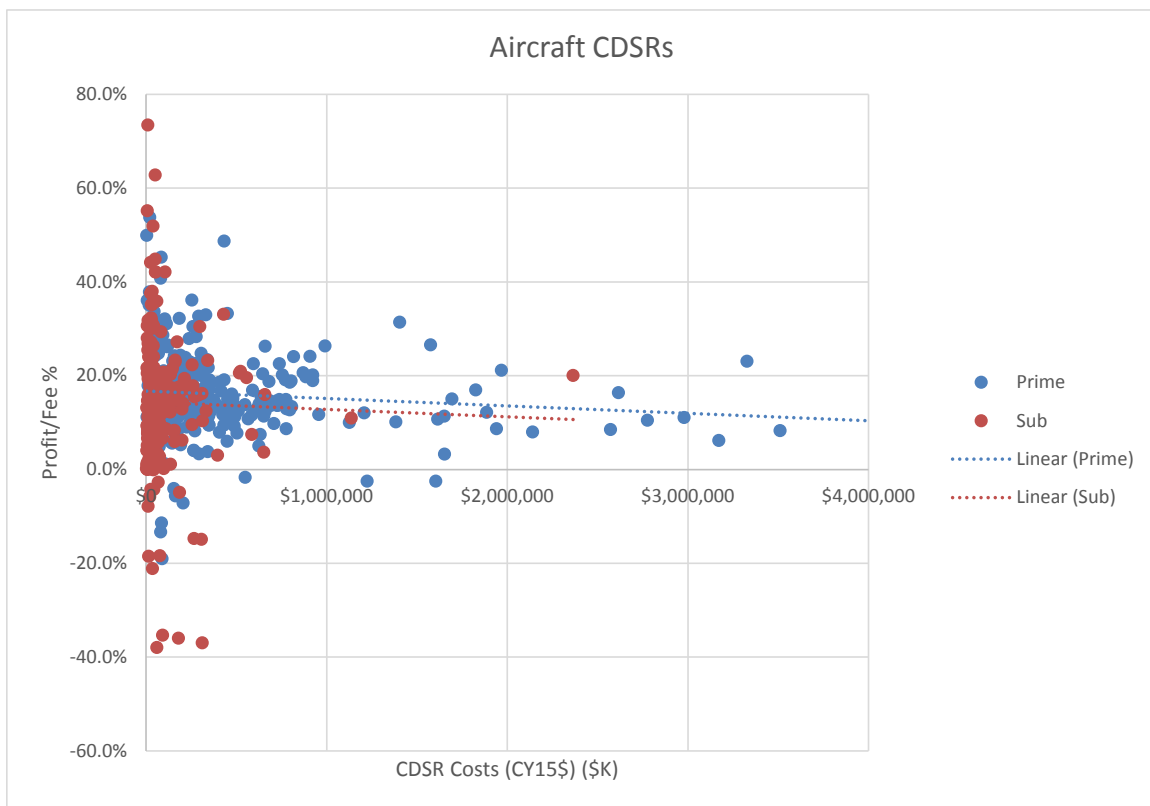
The following figures show contractor profit broken out by aircraft, missiles, and UAVs.



**Figure 19: Commodity (Bar Chart)**

The bar chart in Figure 19: Commodity (Bar Chart) shows the breakout of profit for primes and subcontractors for aircraft, missiles, and UAVs. The only commodity in

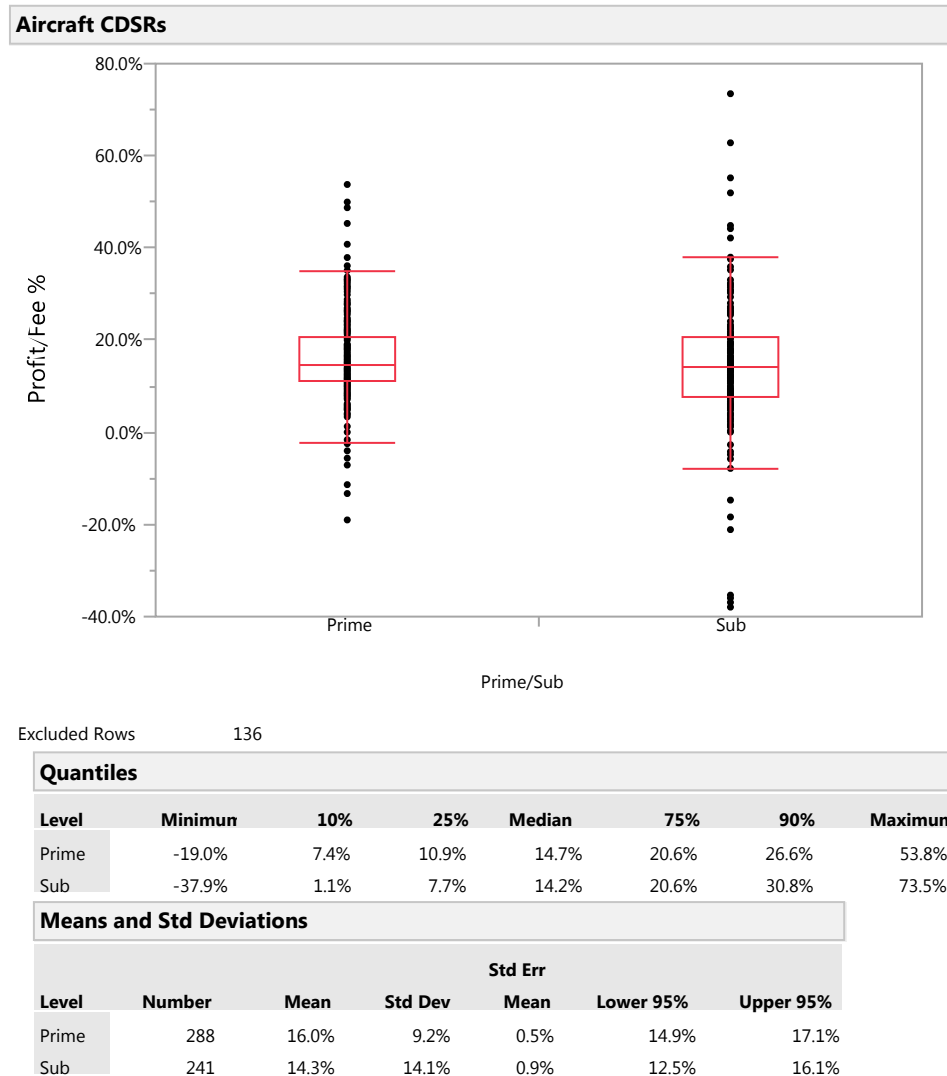
which primes have a higher median profit percentage than subcontractors is for aircraft. There is only a small difference in profit between the two contractor groups for aircraft. It appears that subcontractors for missiles and UAVs have a 4% advantage over their respective primes as shown by the higher median profit percentage for subcontractors. A limitation with the UAV subcontractor data is that there were only seven CDSRs available for analysis.



**Figure 20: Aircraft CDSRs (Scatter Plot)**

Figure 20: Aircraft CDSRs (Scatter Plot) shows profit for aircraft CDSRs. As CDSR costs increase over \$1B, profit for primes tends to stay below 20% for the majority

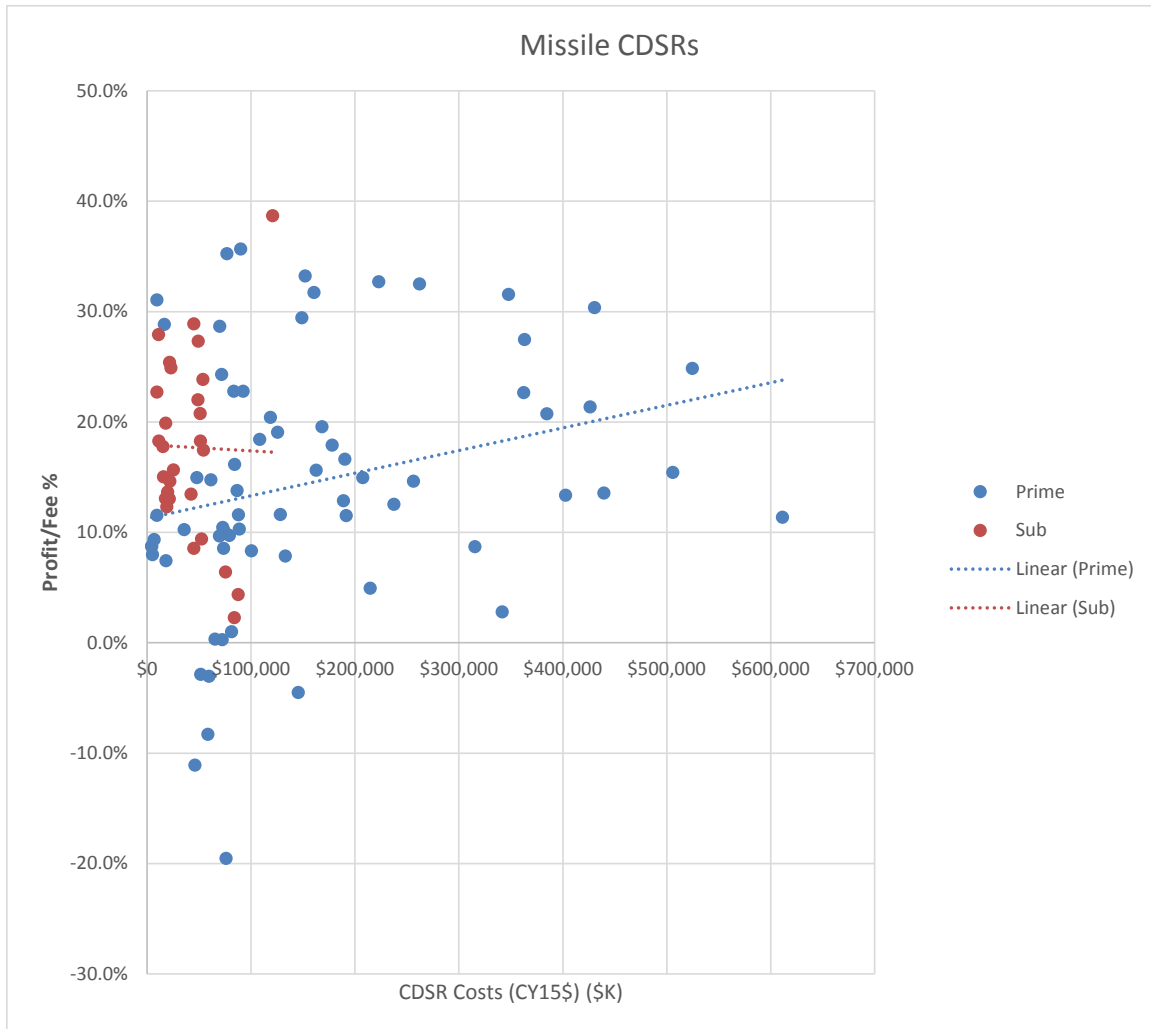
of the cases. There appears to be wider profit variation for subcontractors. Only subcontractors incurred profit losses in excess of -20%.



**Figure 21: Aircraft CDSRs (Box Plot)**

The box plot in Figure 21: Aircraft CDSRs (Box Plot) shows wider variation for subcontractors than primes and that subcontractors have a higher standard deviation. Overall, there is minimal difference with respect to median profit percentage for primes

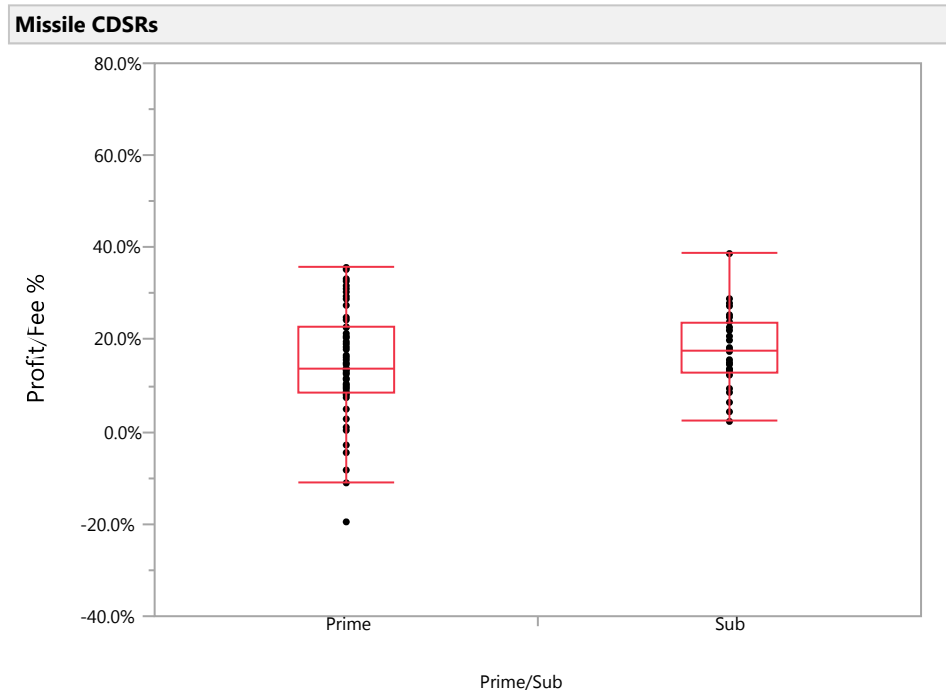
and subcontractors and both groups have large sample populations. There is a larger difference in mean profit between the two contractor groups but their mean confidence intervals predominantly overlap one another. Based on the results, primes probably have a slight advantage for profit received.



**Figure 22: Missile CDSRs (Scatter Plot)**

The graph in Figure 22: Missile CDSRs (Scatter Plot) shows that only the prime has CDSRs with negative profit percentages. The majority of data points for primes and

subcontractors tend to be above 10%. Profit percentages for primes do not appear to decrease as CDSR costs increase. The scatter plot does not show any extreme cases of profit being above 40% for either contractor group.



Excluded Rows 568

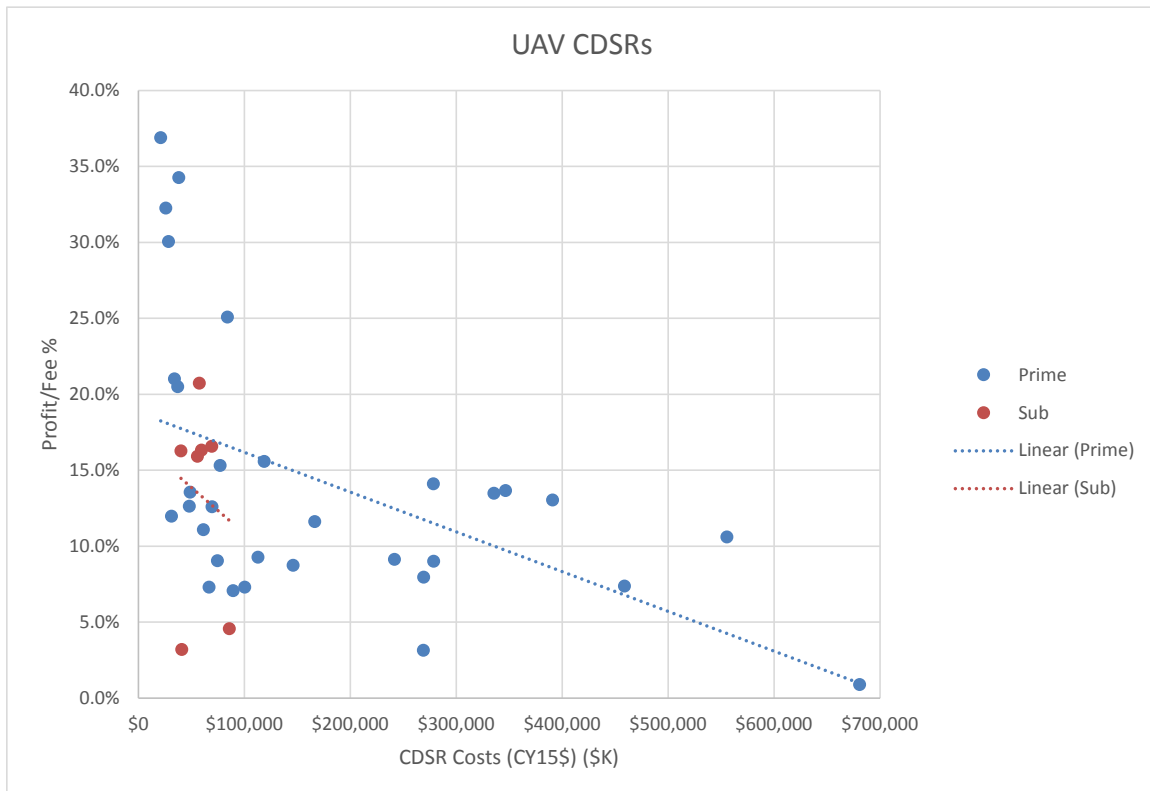
Quantiles							
Level	Minimum	10%	25%	Median	75%	90%	Maximum
Prime	-19.5%	0.3%	8.7%	13.6%	22.7%	31.6%	35.7%
Sub	2.3%	6.2%	13.0%	17.6%	23.6%	28.0%	38.7%
Means and Std Deviations							
Level	Number	Mean	Std Dev	Std Err			
				Mean	Lower 95%	Upper 95%	
Prime	69	14.6%	11.5%	1.4%	11.8%	17.4%	
Sub	28	17.7%	8.2%	1.5%	14.6%	20.9%	

**Figure 23: Missile CDSRs (Box Plot)**

Figure 23: Missile CDSRs (Box Plot) shows a tighter grouping of data points for subcontractors compared to primes and the subcontractors have a smaller standard

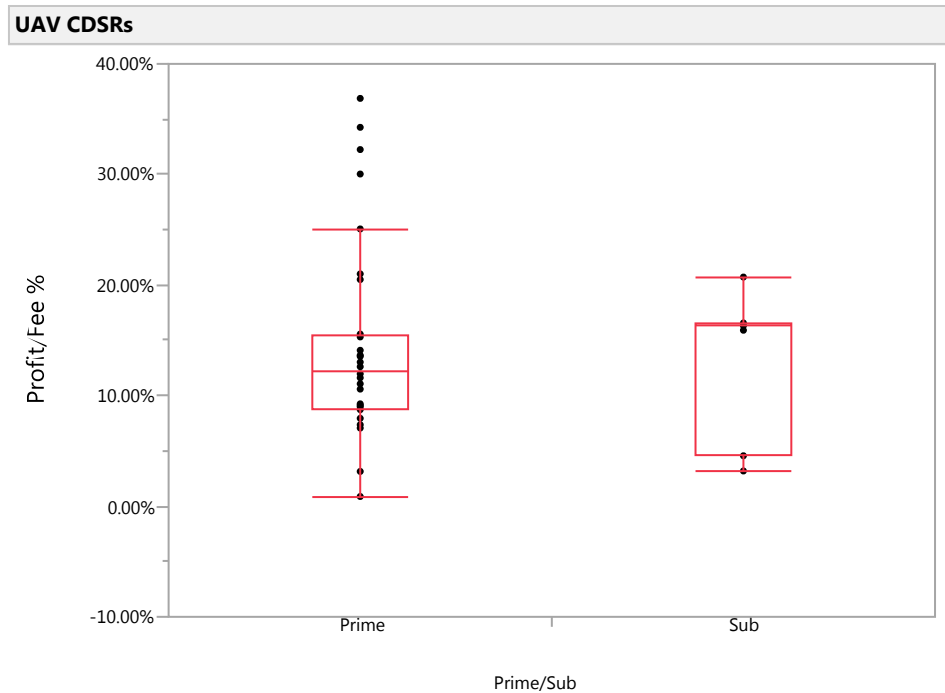


deviation. The results for median profit percentage show subcontractors with an advantage over primes with subcontractors earning 4% higher profit. This is one of the larger differences between the two groups.



**Figure 24: UAV CDSRs (Scatter Plot)**

Figure 24: UAV CDSRs (Scatter Plot) shows a lot of variation in regards to profit for prime CDSRs. Above \$200M, profit for primes stays below 15%. It is difficult to discern any trends about subcontractor profit because of the few data points available for analysis.



Excluded Rows 626

Quantiles							
Level	Minimum	10%	25%	Median	75%	90%	Maximum
Prime	0.9%	7.1%	8.8%	12.3%	15.5%	31.6%	36.9%
Sub	3.2%	3.2%	4.6%	16.3%	16.6%	20.7%	20.7%

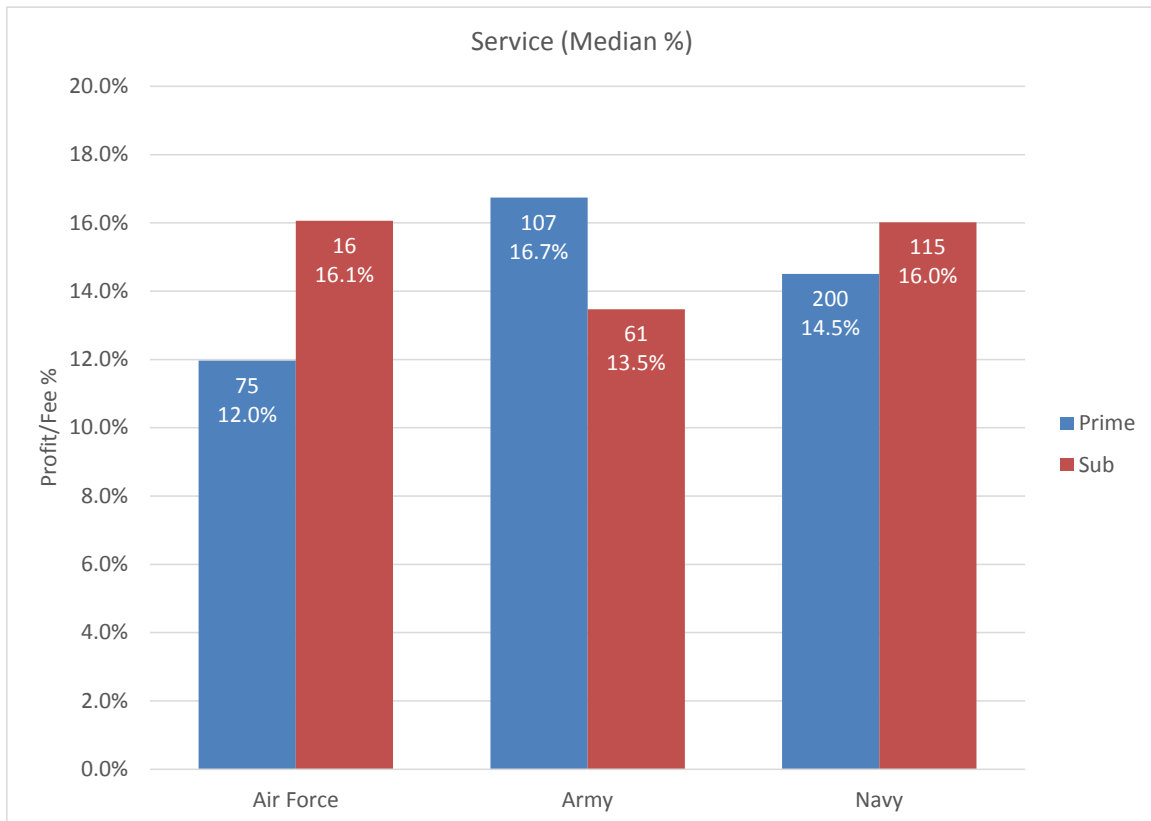
Means and Std Deviations						
Level	Number	Mean	Std Dev	Std Err		
				Mean	Lower 95%	Upper 95%
Prime	32	14.2%	8.8%	1.6%	11.1%	17.4%
Sub	7	13.4%	6.7%	2.5%	7.2%	19.6%

**Figure 25: UAV CDSRs (Box Plot)**

Figure 25: UAV CDSRs (Box Plot) shows that the median profit percentage for subcontractors is higher than for primes, but it is difficult to make any definitive conclusion with only seven data points for the subcontractor. There needs to be more subcontractor data points to determine if one group of contractors has an advantage over the other.

## Service

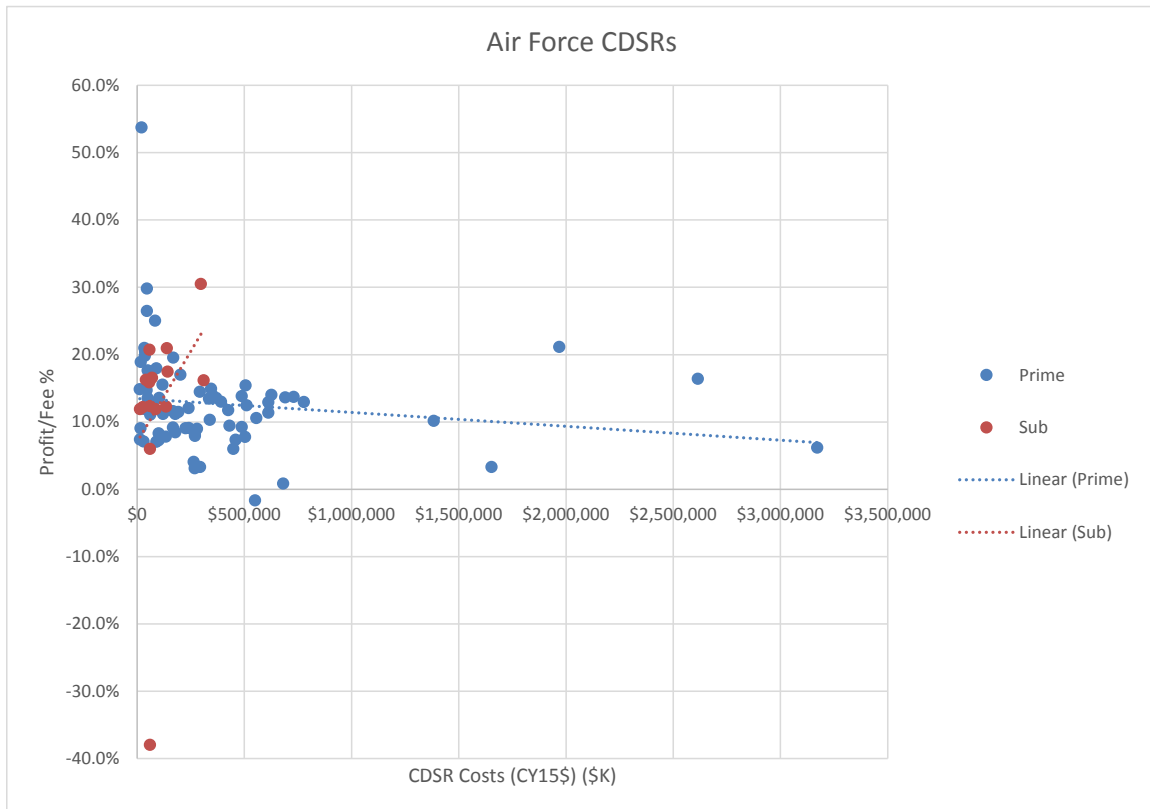
This section discusses the differences in profit for primes and subcontractors for each service: Air Force, Army, and Navy.



**Figure 26: Service (Bar Chart)**

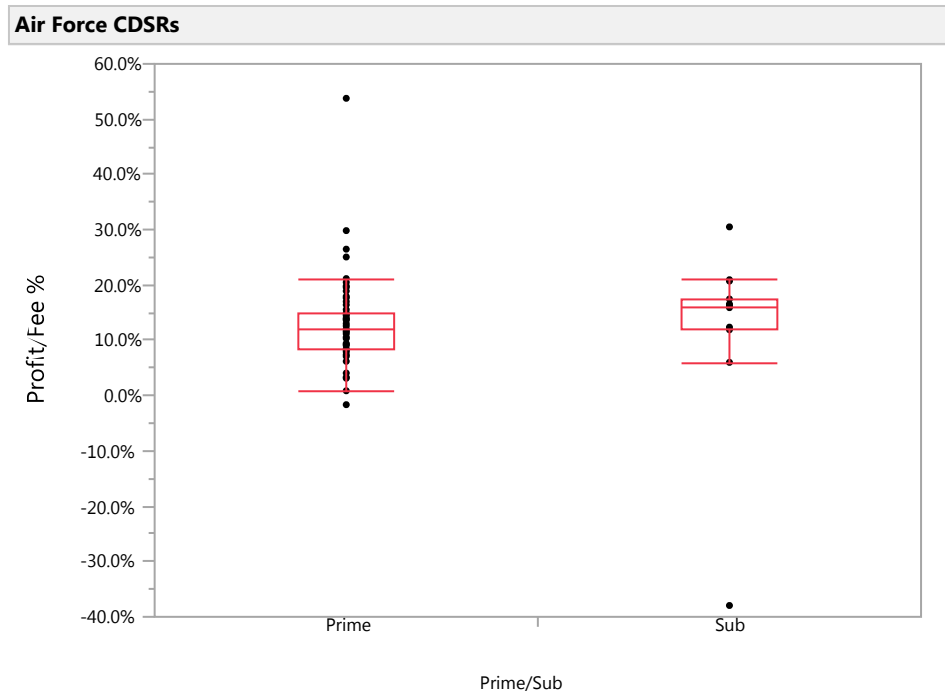
Figure 26: Service (Bar Chart) shows that subcontractors earn higher profit than primes for the Air Force and Navy. The Army is the only service where prime contractors receive a higher median profit of the two contractor groups. In addition, Army primes had the highest profit percentage among primes and subcontractors for all of the services. The Army may have primarily used a different contract type than the

other services, which may have resulted in Army primes having such a high profit percentage.



**Figure 27: Air Force CDSRs (Scatter Plot)**

Subcontractor profit in Figure 27: Air Force CDSRs (Scatter Plot) appears to be concentrated between 10-20%, whereas profit for primes appears to be concentrated between 5-15%. Profit for primes appears to go above 20% in only a few cases. The graph shows a prime and subcontractor outlier. Those outliers could be due to mistakes on the CDSRs or unusual circumstances associated with those programs.



Excluded Rows 574

**Quantiles**

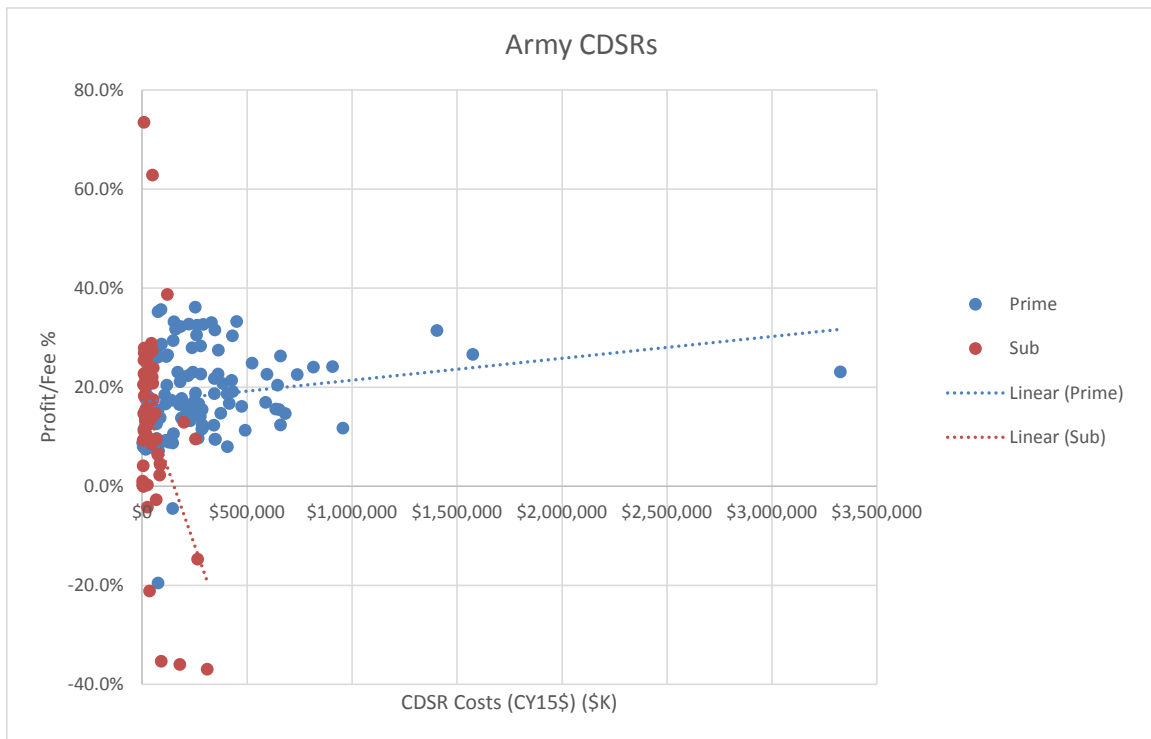
Level	Minimum	10%	25%	Median	75%	90%	Maximum
Prime	-1.6%	6.1%	8.5%	12.0%	14.7%	20.1%	53.8%
Sub	-37.9%	-7.2%	12.0%	16.1%	17.2%	23.8%	30.5%

**Means and Std Deviations**

Level	Number	Mean	Std Dev	Std Err		
				Mean	Lower 95%	Upper 95%
Prime	75	12.7%	7.3%	0.8%	11.0%	14.3%
Sub	16	12.5%	14.5%	3.6%	4.8%	20.2%

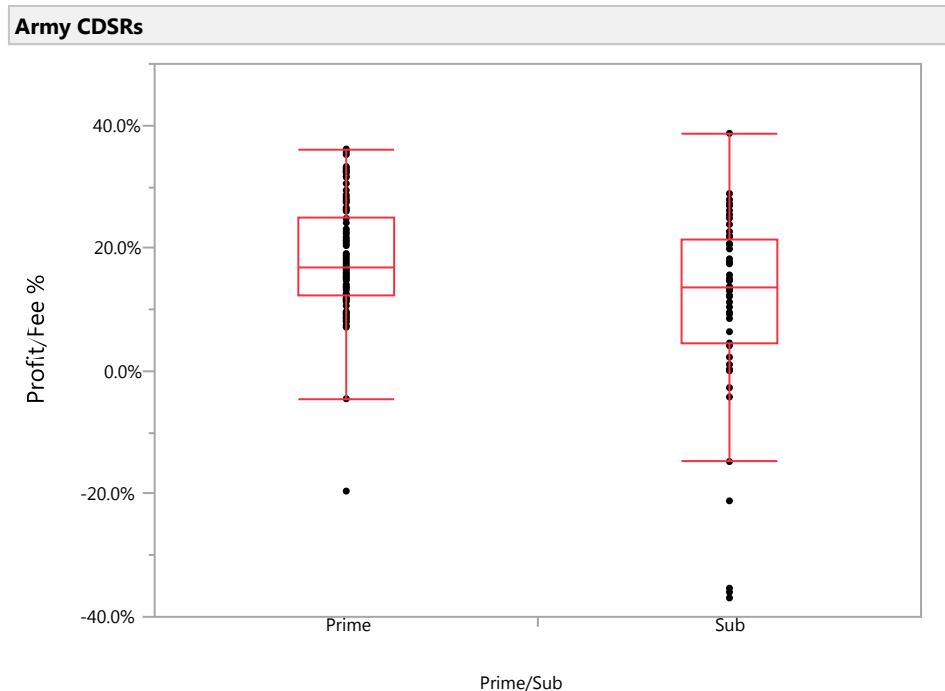
**Figure 28: Air Force CDSRs (Box Plot)**

Although Figure 28: Air Force CDSRs (Box Plot) shows that the median profit percentage is higher for subcontractors than primes, it is difficult to make this determination due to the limited number of subcontractor data points. The box plot shows the median and mean profit percentages for the prime data to be within 1% of each other.



**Figure 29: Army CDSRs (Scatter Plot)**

Figure 29: Army CDSRs (scatter Plot) shows that prime CDSRs for the Army have a number of points above 20%. The three prime CDSRs greater than \$1B all have profit above 20%. Most of the data points below 0% are subcontractor CDSRs. Subcontractor CDSRs appear to have a larger profit dispersion than prime CDSRs.



Excluded Rows 497

#### Quantiles

Level	Minimum	10%	25%	Median	75%	90%	Maximum
Prime	-19.5%	8.7%	12.3%	16.7%	24.9%	31.8%	36.1%
Sub	-36.9%	-3.9%	4.5%	13.5%	21.3%	27.2%	73.5%

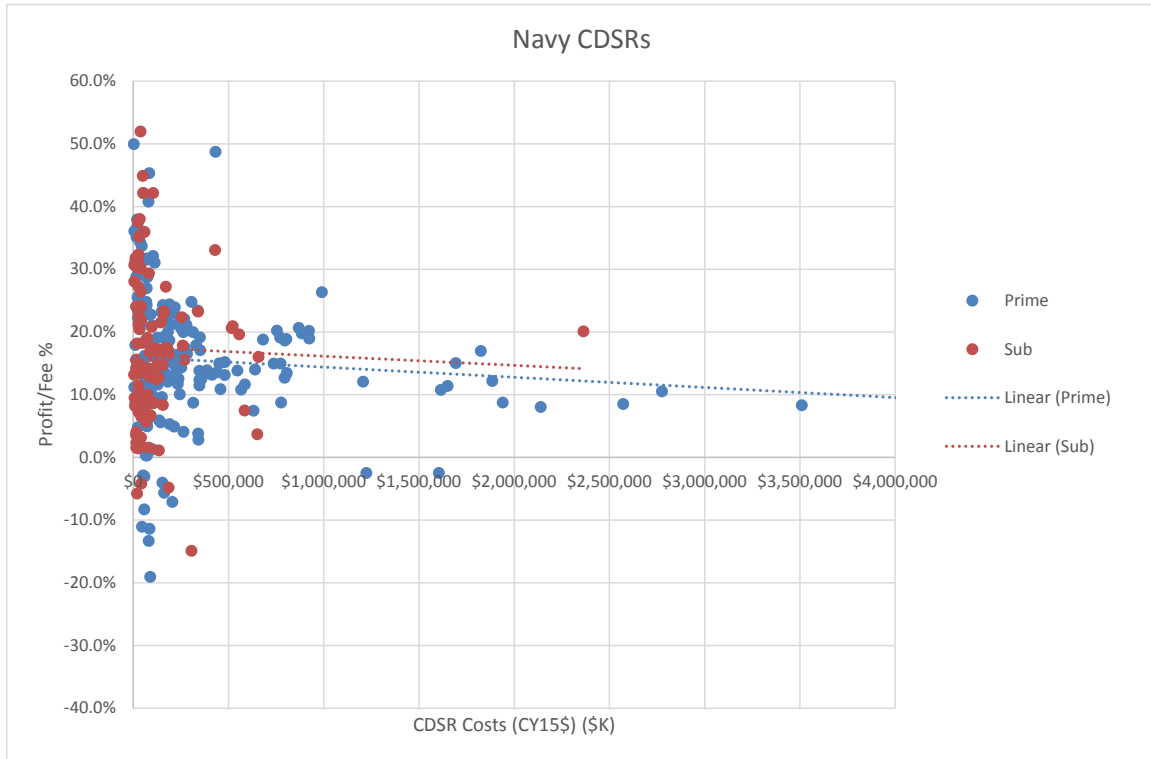
#### Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err		
				Mean	Lower 95%	Upper 95%
Prime	107	18.4%	9.1%	0.9%	16.7%	20.2%
Sub	61	12.4%	18.2%	2.3%	7.8%	17.1%

**Figure 30: Army CDSRs (Box Plot)**

Figure 30: Army CDSRs (Box Plot) shows that 90% of Army prime CDSRs have profit greater than 8.7% with a median profit percentage more than 3% higher than subcontractors. The mean 95% confidence interval for Army primes slightly overlaps the mean confidence interval with subcontractors. This means that there is a strong likelihood that there is a difference in means between primes and subcontractors for the Army. In addition, the standard deviation for Army subcontractors is twice as large as

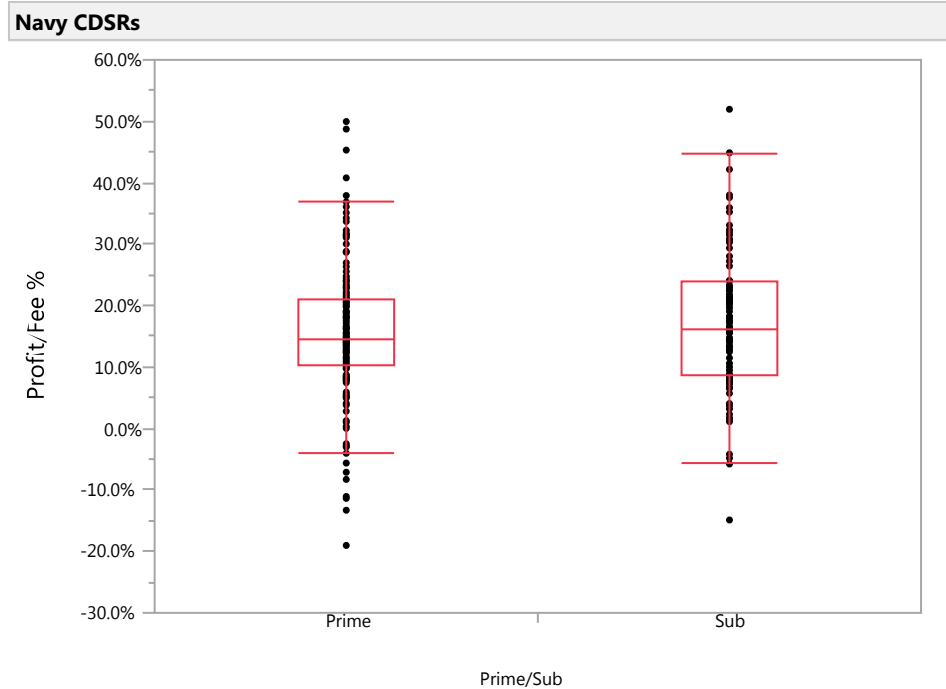
the standard deviation for primes. This means there is probably a lot of variability in profit for subcontractors.



**Figure 31: Navy CDSRs (Scatter Plot)**

Figure 31: Navy CDSRs (Scatter Plot) shows that the majority of prime CDSRs have profit that falls between 10-30%. Subcontractor profit appears to be mostly concentrated between 5-25%. CDSRs for both primes and subcontractors show negative profit, with primes having a few more occurrences of negative profit. Both contractor groups show slight downward trends. In addition, both contractors have one or two CDSRs with profit around 50%. There appear to be no data points extremely far from the rest of the data for either contractor group.





Excluded Rows 350

Quantiles							
Level	Minimum	10%	25%	Median	75%	90%	Maximum
Prime	-19.0%	4.2%	10.3%	14.5%	21.0%	28.8%	50.0%
Sub	-14.9%	2.8%	8.6%	16.0%	24.0%	33.9%	52.0%
Means and Std Deviations							
Level	Number	Mean	Std Dev	Std Err			
				Mean	Lower 95%	Upper 95%	
Prime	200	15.4%	10.4%	0.7%	13.9%	16.8%	
Sub	115	17.4%	11.9%	1.1%	15.2%	19.6%	

**Figure 32: Navy CDSRs (Box Plot)**

Figure 32: Navy CDSRs (Box Plot) shows profit occurring over similar ranges between Navy primes and subcontractors. As shown on the box plot, Navy primes tend to have more profit data points below zero compared to subcontractors. Navy subcontractors have a higher median and mean profit percentage than primes. In addition, the mean confidence interval for subcontractors is higher than it is for primes.

It appears that Navy subcontractors have an advantage over prime contractors in terms of profit percentage.

### **Summary**

The researchers presented the differences in profit between prime contractors and subcontractors by multiple breakouts to include phase, contract type, commodity, and service. A mixture of bar charts, scatter plots, and box plots were the methods the researchers used to show the differences in profit for primes and subcontractors. The researchers did not find one contractor group to have a consistent advantage over the other group. There were times both groups of contractors practically had equal median profit percentages. At other times, the contractor group with the advantage changed within the field examined.

## **V. Conclusions and Recommendations**

### **Chapter Overview**

In chapter 5, the researchers discuss and summarize their profit analysis between primes and subcontractors by phase, contract type, commodity, and service, and discuss the significance of their findings. Next, the researchers discuss the limitations involved of this study such as population size and the indeterminacy surrounding the year of contractor funding. Lastly, the researchers review recommendations for future research such as including other commodities not analyzed in this study.

### **Conclusions of Research**

Across all the breakouts analyzed between prime contractors and subcontractors for profit percentages, neither group had a clear consistent advantage. The cases where profit percentages for primes and subcontractors were analyzed by only one factor, (i.e. phase, contract type, commodity, or service), neither group of contractors seemed to have a consistent advantage over the other group in regards to lower bound median profit. In this situation, there were two times in which the median lower bound profit between the two groups was less than 0.5% apart, five cases where the median profit for primes was at least 0.5% greater than profit for subcontractors, and five cases where subcontractors' median profit was at least 0.5% greater than profit for primes.

This section lists the profit percentages received for each group according to the various categories analyzed with profit for prime contractors (P) listed first and profit for subcontractors (S) listed second. The difference in median profit percentages between the two groups for the entire sample population was very small, 14.3% (P) vs 14.6% (S).

In the development phase, primes appeared to have an advantage over subcontractors, 8.3% (P) vs 6.7% (S). Whereas in production, there appeared to be very little difference between the two groups, 15.0% (P) vs 15.1% (S). There was not a consistent frontrunner across contract types either. For cost reimbursable contracts, subcontractors received a substantially higher percentage of profit than primes, 9.0% (P) vs 13.0% (S). Primes and subcontractors had a smaller difference in profit percentages for fixed-price type contracts than for cost reimbursable contracts, but primes appeared to have the advantage for fixed-price type contracts, 16.6% (P) vs 15.5% (S). Other type contracts, which are a mixture of cost reimbursable and fixed-price type contracts, show that primes have an advantage over subcontractors, 12.9% (P) versus 11.2% (S). The next section reviews the breakout of profit percentages for commodity type and service.

The aircraft commodity had the largest number of data points in this study. Primes and subcontractors showed a minimal difference with a slight advantage for primes, 14.7% (P) vs 14.2% (S). Subcontractors had a substantial advantage over primes for missiles, 13.6% (P) vs 17.6% (S). Similar to missiles, subcontractors appeared to have the advantage over primes for UAVs, 12.3% (P) vs 16.3% (S).

Across services, subcontractors tended to have an advantage over primes. Subcontractors to Air Force primes appeared to have a substantial advantage over primes, 12.0% (P) vs 16.1% (S). Navy subcontractors showed an advantage over primes, 14.5% (P) vs 16.2% (S). Lastly, Army primes showed an advantage over subcontractors and this was the only service in which prime contractors had a higher median profit percentage than subcontractors, 16.7% (P) vs 13.5% (S).

### **Differences with *Analysis of Subcontractor Margins***

The results in this research were different from the *Analysis of Subcontractor Margins* due to different methodologies. The research of this study analyzed profit percentages only for aircraft, missiles, and UAVs. The *Analysis of Subcontractor Margins* did not mention its research population as being limited to only certain commodities. The *Analysis of Subcontractor Margins* limited its research population to only programs with both a prime contractor and subcontractors, this study did not. In addition, the *Analysis of Subcontractor Margins* calculated weighted median profit percentages to present its results whereas the research in this study calculated unweighted median profit percentages. Lastly, the *Analysis of Subcontractor Margins* calculated profit percentages as profit over contract price, but this study calculated profit percentages as profit over contract costs.

### **Significance of Research**

The significance of this research is that it helps determine whether contractors gain an advantage in terms of profit percentage by not working directly with the Government. In addition, this research attempts to show whether primes try to restrict subcontractors to a similar profit percentage received by the prime. The research indicates that neither primes nor subcontractors always have an advantage over the other across the different categories. The contractor group with an advantage over the other depends on the phase, contract type, commodity, and service. The research highlights that subcontractors do not always earn more profit than primes and that dealing directly with the government does not necessarily dictate lower profit percentages for primes.

## **Limitations**

One limitation of this research is the lack of data points. The researchers were unable to use all of the CDSRs in the query export. In addition, this study does not cover all of the CDSRs in DACIMS. Certain factors may disproportionately influence the results of this research. A large percentage of the research population was comprised of production CDSRs (91.6%), fixed-price type contract CDSRs (70.1%), and Navy CDSRs (47.4%). Some factors analyzed did not always have a good population size for primes or subcontractors, or even both. There were only seven CDSRs for UAV designated system subcontractors, which makes it difficult to make any significant conclusion for the difference between UAV primes and subcontractors. Spending on individual development and production CDSRs occurs over multiple years, but it was difficult for the researchers to know exactly the correct year of spending for each CDSR effort. This limits the usefulness of the scatter plots since the researchers were not able to escalate costs accurately for each CDSR.

The methodology of this research is another limitation of the results in this study. The researchers only used CDSRs with completion costs between 95-100%, which reduced the number of data points available for analysis. Another step performed by the researchers involved combining subcontractor data with prime data in cases where subcontractors had profit listed on the prime's CDSR. The researchers excluded data found in the export query but not listed in the DACIMS library. In addition, the researchers excluded data not designated as either development or production. Of the 75 pairs of CDSRs the researchers believe to have duplicated costs, two of those pairs were

not exactly the same after further review. What appeared to be duplicated CDSRs in a couple of cases actually appear to be corrections to earlier versions.

Types of contracts used and type of work may be limiting factors of this research. Although the researchers categorized all contracts as fixed that did not include cost-reimbursable efforts, there are differences between fixed-price type contracts. Firm-fixed-price (FFP) efforts may lead to different profit results for contractors versus fixed-price-incentive-fee (FPIF) contracts. Using the same method as fixed-price type contracts, the researchers placed all cost reimbursable efforts in the same group. This may limit the results because cost-plus-fixed-fee (CPFF), cost-plus-incentive-fee (CPIF), and cost-plus-award-fee (CPAF) contracts may all result in different profit for a contractor.

Another limitation of the results may be due to the type of efforts for each CDSR. CDSRs involving the production of a weapon platform may result in different profit percentages than a CDSR for a modification effort. The standard deviation of the data may also limit the results. A large portion of the data had standard deviations equivalent to their respective median and mean profit percentages. The mean and median may not be a good representation of the data due to the high standard deviations. Lastly, another limitation is that the prime profit calculation includes all subcontracted cost (and profit) as part of the primes “cost.” In actuality, the prime may have done very little “work” but still receive profit on this.

### **Recommendations for Future Research**

Future research for comparing the profit percentage between primes and subcontractors could include analyzing other commodities such as electronic/automated

software, ordnance, ships, space, surface vehicles, and system of systems. These commodities may show different results due to the different types of effort involved in the development and production process. Another recommendation is to compare the differences for contractors that perform both prime and subcontractor tasks. Some contractors may receive higher profit as a subcontractor than as a prime even though the category analyzed shows primes outperform subcontractors. Some contractors may be better at negotiating with other contractors than with the government. Since a prime's costs include subcontractor costs, another idea for future research is to quantify the "actual" value of work by the prime. This would likely show the prime profit percentage to be significantly higher.

This study did not include all the available data for the three commodities analyzed. New research could include analyzing the remaining CDSRs to determine if the results stay the same since the research data population did not include all data available. In addition, new research could include analyzing any CDSRs with costs at or above 90% complete. This would increase the number of data points available for analysis and may allow for a more rigorous statistical analysis. If more data is collected, another area of interest is to analyze the change in profit percentages between primes and subcontractors over time. This would allow researchers to identify any potential trends over time and compare the trends to new regulations and the economy to see if these events have a noticeable or statistically significant impact on the results. Lastly, the research could apply statistical analysis tests to determine if the differences between primes and subcontractors are statistically significant.



## **Summary**

In conclusion, the researchers analyzed contractor profit to determine if differences exist between prime and subcontractors for aircraft, missiles, and UAVs. The researchers did not find one group to have a consistent advantage over the other, but there were times when there were significant differences between the two groups of contractors. Further research is required to determine if these results hold true for other commodities and to determine if changes to government contracting regulations could influence these results in the future.

## **Appendix**

To obtain access to the Appendix, please contact the following:

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## **Vita**

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14. ABSTRACT In order to achieve its mission of providing the military forces needed to deter war and to protect the security of our country; the Department of Defense (DoD) routinely acquires new weapons systems. The DoD acquires these systems by contracting the design, development, and manufacture to defense contractors. Many of today's systems are highly complex systems of systems comprised of many specialized components. For systems such as these, the primary defense contractor tends to subcontract out parts of the effort to other defense contractors for these specialized subcomponents. The purpose of this study was to determine if there is a profit advantage in either having a prime contractor or subcontractor role within DoD systems acquisition. The researchers used contractor cost data for programs from the aircraft, missiles, and UAV commodities to see if one contractor group has an advantage over the other group. The researchers analyzed this data by phase (development/production), contract type (cost reimbursable, fixed, and a mixture of the two), commodity, and service (Air Force, Army, and Navy). The researchers found neither contractor group to have a consistent advantage over the other.					
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